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(10) Doreen / Behmke
Everett / Cahall

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LAKEHURST, NEW JERSEY 08733

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19 May 1978

FINAL REPORT

PRESERVATION AND PACKAGING OF LAUNCHER AND RECOVERY SYSTEMS COMPONENTS AND CORROSION CONTROL OF CATAPULT PNEUMATIC SYSTEM IN MARINE ENVIRONMENT

PREPARED BY D. Behmke
D. BEHMKE

E. CAHALL

APPROVED BY J. E. Smith
J. E. SMITH

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The study was separated into two phases of investigation. Phase I covered the design of Preservation and Packaging requirements for Launcher and Recovery Systems components while Phase II was limited to the corrosion control of the catapult pneumatic system and its components.

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I. INTRODUCTION

The primary objective of this design study was to investigate the current NAEC Preservation and Packaging Design Procedure used for Launcher and Recovery Systems components (Figure 1) and determine the effectiveness of its implementation. A segment of this study was to make a detailed investigation of NAEC Field Reports which concerned defective components detected in the field. In conjunction with the basic design study, a brief search was concluded among industry and military agencies for new packaging materials and techniques which would improve the "state of the art" capability.

The associated objective of this design study was directed towards a limited investigation into the corrosion aspect of the catapult pneumatic system (Figures 2 and 3) and methods and materials to control and prevent component corrosion.

II. SUMMARY

The study was separated into two phases of investigation. Phase I covered the design of Preservation and Packaging requirements for Launcher and Recovery Systems components while Phase II was limited to the corrosion control of the catapult pneumatic system and its components.

A. PROCEDURES AND RESULTS.

1. Preservation and Packaging of Components.

a. Surveyed current NAEC procedures (References 1, 3, 4) for determining Preservation and Packaging of these components and made recommendations to improve system.

b. Initiated a limited field survey to determine effectiveness of current NAEC Preservation and Packaging Procedures, and documented pertinent deficiencies.

c. Analyzed NAEC Field Reports (Appendix F) on corroded parts to determine why deficiencies occurred; examined related NAEC drawings, reports, etc. and documented recommendations.

d. Conducted an abbreviated literature search through correspondence and personal contact with various military agencies and companies for improved materials or techniques for Preservation and Packaging; documented the availability of improved materials or techniques.

2. Corrosion Control of Catapult Pneumatic System.

a. Completed a study of the operation and design features of the catapult pneumatic system and components (Figures 4 and 5) utilizing specified drawing (Reference 8) and operation manual (NAVAIR 51-15AAA-1) and had discussion on the system design with NAEC Engineering personnel. Obtained design parameter data (approximate flow rates, cycle time etc.).

b. Discussed design of ship's high pressure air system with NAVSEC Engineering personnel and obtained drawings and manuals data (References 9, 10, 11) used to determine its relationship with the catapult pneumatic system (Figures 6 and 7).

c. Conducted a field survey with NAEC field personnel to determine what their experiences were with corrosion and maintenance problems in the operation of the catapult pneumatic system.

d. Completed a literature search on methods (coatings, equipment) of corrosion prevention applicable to the catapult pneumatic system. Obtained materials and technical data (Appendixes J, K, L) related to these applications.

B. CONCLUSIONS.

1. Preservation and Packaging of Components.

a. Evaluation of NAEC Preservation and Packaging Procedures (Chart 1).

The current NAEC preservation and packaging procedures for launcher and recovery systems components follow the basic MIL-Specifications (MIL-STD-794, MIL-P-116 etc.) established for military packaging and preservation. The authorized NAEC Packaging Instructions (Reference 3) refer to these specifications for the level of protection of their items of supply; and Branch Aviation Supply Office Authorized Documents, of which Reference 4 is typical, specify Level "A" (per MIL-STD-794) for their items of supply. However, some refinements are required within the overall system to improve control of all items delivered to the ultimate users (catapult & arresting gear personnel).

(1) No permanent assignment has been established in the Launcher and Recovery Systems Design Groups for designing special packaging containers and maintaining an up-to-date knowledge in preservation and packaging of their components.

(2) The NAEC Industrial Department is responsible for the preservation and packaging of components delegated to their control (References 1 and 3). In the procedure (Reference 3), they utilize methods and materials currently specified in MIL-P-116, but do not maintain a "state of the art" improvement program on preservation and packaging. They do not specify or mark packaged items as "critical" for handling.

(3) Inadequate marking of the packages does occur at the source of manufacture. Consequently, packaged components are delivered to the user (launcher and recovery systems personnel) with improper or incomplete markings (numbers or nomenclature omitted, illegible, etc.).

(4) Reports are issued by field personnel indicating defective components detected in the field (depot or ship board). However, there is no Line Item included on the forms (Appendix E-1, -2) to indicate problems found in the preservation and packaging of components.

(5) The investigation of defective component reports revealed that adequate preservation and packaging was initially specified for the items by the cognizant supply agency (BRASO) and the defined discrepancies (rust and corrosion) resulted from subsequent improper handling. (i.e., opening for inspection, component identification etc. and not repacked to the original level.)

(6) A materials study revealed new strippable materials (similar to MIL-P-149) are available (Chart II) to provide improved protection for preserving parts. Evaluation and application of these new materials to launcher and recovery systems components could possibly improve current protection.

(7) No present program for indoctrination and training of fleet personnel for handling and control of critical components has been established.

2. Corrosion Control of Catapult Pneumatic System.

a. Moisture Prevention in the Pneumatic System.

A brief engineering study of the catapult pneumatic system indicated a source of corrosion in the system was due to moisture laden air supplied by the ship's high pressure (3000 PSI) system (Figure 7).

A survey by NAEC Field Technicians of aircraft carriers (CV 62, CV 42; CV 63) in port at Norfolk, Va., Mayport, Fla. and San Francisco, Calif. revealed an inconsistency in the maintenance procedures utilized in the operation of the ship's high pressure air (3000 PSI) drying equipment (compressed air dehydrators; Reference 10). Due to these operational variations between ships' equipment, an analysis could not determine whether the high pressure air dryers installed aboard ship were efficient enough to control the moisture content of the high pressure compressed air, or if the lack of adequate maintenance procedures contributed to the inefficiency of operation of the dryers in controlling the quality of compressed air delivered to the catapult pneumatic system. Consequently, a more detailed study of the efficiency of the ship's high pressure air system must be made. This will require operating a ship's high pressure air system with all the appropriate maintenance procedures (manual, MRC, etc. verified) in effect and then conduct an analysis of the quality of air being delivered to the catapults' air flask (Figure 4). If the air is then found to contain moisture it will require the installation of a separate dryer in the catapult pneumatic system (Figure 6).

b. A materials search indicated that new protective coatings (Chart II) are available for corrosion control applications of catapult components. An evaluation of the application of these new coatings to launcher and recovery systems components could possibly improve current protection.

c. A literature search revealed the availability of current reports on methods and materials to control corrosion.

C. FUTURE ACTION.

1. **Preservation and Packaging of Components.**

a. **Evaluation of NAEC Preservation and Packaging Procedures.**

(1) The Launcher and Recovery Systems Design Groups should contain personnel who have technical cognizance of the latest preservation and packaging systems as applicable to their components. In this capacity these individuals would be responsible to:

(a) Coordinate all technical data related to preservation and packaging of their materials with Materials and Process Office, Supply Department, Quality Assurance Department, etc.

(b) Review pertinent component drawings and determine which components require critical considerations in methods of preservation and packaging.

(c) In-house review of all reports (Field, Quality Assurance etc.) related to preservation and packaging. Maintain continuous contact with field personnel to evaluate package handling, stowage or other logistic problems developed aboard ship.

(d) Be responsible for all special container designs.

(e) Maintain continuous contact with other Government Agencies (i.e., packaging labs) and manufacturers of packaging and preservation materials to implement the latest "state of the art" knowledge of preservation and packaging systems, techniques, and processes.

(2) The Industrial Department should participate in "state of the art" improvement program for preservation and packaging of their components; they also should mark all packaging of critical items accordingly, and in the same manner as BRASO so that a standard preservation and packaging system will evolve.

(3) Marking spec MIL-STD-129 provides for optional special handling marking (Paragraph 5.4.28, MIL-STD-129). NAEC procedures should provide additional notification markings; "critical, if opened for inspection repackage to Level A per MIL-STD-794". More detailed packaging instructions should be supplied to manufacturing source inspection with utilization of a modified form similar to Chart V.

(4) Preservation and packaging problems should be incorporated as line items on form; "NAEC 2104 (Rev 8/69)" as line 15 item; "NAEC 13810/5 (Rev 3-73)" as part of line 14 item "corrosion control/packaging problems".

(5) To lower the frequency of these defective component problems, better instructions should be given to update handling personnel (field and fleet) concerning the importance of maintaining complete packaging and preservation of the system until used. More utilization of notice marking (Item 3 above) should be effected.

(6) Further investigation and evaluation of new materials (Chart II) is needed for improved NAEC preservation and packaging system, techniques and processes.

2. Corrosion Control of Catapult Pneumatic System.

a. Moisture Prevention in the Pneumatic System (Figure 3). To determine if the source of moisture accumulation in the catapult pneumatic system is due to the inefficiency of the ship's high pressure air dryer a test must be performed on an approved air carrier high pressure air system. The system should have the high pressure compressor (Reference 9) and air dryer (Reference 10) equipment checked in accordance with the prescribed maintenance procedures and then operated. An analysis of the high pressure air then being delivered to the catapult air flask should be made for moisture content. If the quality of air is not dry as required then an auxiliary air dryer (Figures 8 and 9) should be installed in the catapult pneumatic system (Figure 3) directly to the air flask adjacent to the retraction engine installation. Space is available aboard ship (Figure 6) to provide for the installation of this equipment.

If the quality of high pressure air is as dry as required for the operation of the catapult pneumatic system then the maintenance procedures utilized for the test air system should be incorporated aboard all aircraft carrier's high pressure (3000 PSI) compressed air systems.

b. Evaluate the new materials cited in Chart II for application as corrosion preventative coatings for catapult components (air flask, accumulator, etc.).

c. The reports, abstracts, indicies, (Appendix J) documented as a result of the literature search are a source for future investigation on corrosion control by NAEC.

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A. INTRODUCTION.

1. Study Objectives.

a. Preservation and Packaging. The primary objective of this design study was to investigate the effectiveness of the current design procedure utilized at NAEC for preservation and packaging of launcher and recovery systems components for stowage and use in a marine environment.

A subsequent part of this study was to investigate the preservation and packaging methods used for specific equipment components which were the subject of NAEC field reports (Appendix F). These components were reported as being received in the field in a corroded condition as a result of improper preservation and packaging. In conjunction with these studies was a limited literature search for improved or new materials and techniques for strippable coatings similar to MIL-P-149 to be used for preservation and packaging of these components. The field of the search included both military agencies and industry.

b. Corrosion Control. An associated objective of this design study was to investigate improved methods and materials to prevent corrosion of catapult pneumatic system and components (such as; air flask and accumulator Figures 4 and 5) related to its operation in a varied marine environment.

2. Military Packaging Requirements. (Chart III)

The rigid requirements of Military Preservation and Packaging of material is predicated on the need to insure delivery of critical maintenance supplies any place in the world in a usable condition. The problems of corrosion control, of which preservation and packaging is a segment, are much more complex since world-wide environments became standard modes of operations and storage. Adequate preventive methods are available without regard to cost. However, since there is an important economic consideration, a constant research effort into new materials and techniques must be maintained to reduce the cost versus improvement relationship; this continuing research is constantly being shared by all branches of the military as well as industry.

The Preservation and Packaging Procedures at NAEC utilize all the principle packaging design specifications available as well as many of their own special design techniques. This is particularly the case of the catapult and, arresting gear components whose uniqueness in shipboard and shorebased storage constantly requires meeting the demands of environmental extremes. These conditions require a continued technical surveillance by NAEC to improve processes and materials which resist corrosion and will provide usable supplies.

3. Program Requirements.

a. Preservation and Packaging. The contract work outline specified a design study of the NAEC Preservation and Packaging Procedures of launcher and recovery system components for a marine environment. Of particular interest in this phase of the study was the investigation of new or improved materials (similar to MIL-P-149) and related application techniques.

b. Corrosion Control. The work outline further specified a separate study on the corrosion aspect of the catapult pneumatic components (such as; air flask, accumulator, etc.) when operated within environmental extremes (high humidity, salt air, etc.), and the subsequent investigation of new materials (coatings) and techniques to prevent this corrosion of components.

4. Study Approaches.

a. Talked with personnel within various NAEC Departments and obtained data, forms, instructions, etc. used by them in conjunction with preservation and packaging procedures.

b. Discussed with NAEC field personnel problem areas they found relative to the study objectives and obtained pertinent data to support these findings.

c. Reviewed design features of pneumatic system with NAEC engineers and high pressure air system with NAVSEC engineers. Received drawing data, reference manuals, specs, etc. from them.

d. Researched libraries, manufacturer's indicies, technical association report lists, Defense Documentation Center, NAEC Technical Data Center, Naval Publications and Forms Center, etc. for information relative to packaging and corrosion control.

e. Obtained data, material and costs from manufacturers of protective coatings and pneumatic equipment. Read technical reports, engineering books, trade journals etc.

f. Examined NAEC Field Reports on corroded parts and reference drawings, reports, specifications, etc.

5. Anticipated Results.

It was expected that the initial phase of study would result in improvements in NAEC Preservation and Packaging Procedures which would insure the delivery of usable parts to the fleet.

The subsequent second phase of study was expected to reveal methods (new coatings, processes, etc.) to improve the corrosion protection of the catapult pneumatic system or components in a marine environment.

B. PROCEDURES.

The study procedures involved a systematic liaison with many organizations and sources of information which had delegated responsibilities related to the technology of preservation and packaging of military and commercial products.

This course of investigation involved personal surveys and discussions with personnel at the Lakehurst Facility. NAVSEC Command personnel, NAEC field personnel and fleet personnel. It also included direct correspondence with other government agencies and a literature search of packaging oriented sources for the most recent data on packaging techniques and materials. Finally a detailed investigation was conducted on NAEC Field Reports for defective components detected at field locations.

A companion study procedure was followed with the emphasis on the corrosion control of the catapult pneumatic system. In many instances the source of information was germane to both topics.

1. Preservation and Packaging of Components.

a. Surveys

(1) NAEC Departments and Associate Branch. Initial liaison was made with specific NAEC departments and associate branch personnel who are responsible for the design procedures used in the preservation and packaging of launcher and recovery systems components. These departments included; Engineering, Industrial, Supply, Quality Assurance, Fleet Services, Engineering Specifications and Standards as well as the Branch Aviation Supply Office. From this initial survey it was determined the scope of responsibility for each NAEC department (References 1 and 3) and BRASO (References 3 and 4) in relation to the preservation and packaging of components (Chart I).

(a) NAEC Engineering Department. The NAEC engineering has design cognizance of all aircraft Launcher (catapult) and Recovery (arresting gear) Systems used aboard ship with the exception of those noted in Reference 2. In conjunction with this design responsibility they supply technical data related to preservation and packaging of components of these systems where necessary. This information is delineated on drawings, in material process specifications, special container designs or appropriate MIL commodity design specification for specific components. In addition they supply technical support to other departments in regards to specialized preservation and packaging data of these components.

(b) NAEC Industrial Department. The Industrial Department has primary responsibility for specifying the preservation, packaging and packing requirements for all procurement of parts initiated by their department (References 1 and 3) and also has cognizance of the preservation and packaging of in-house manufactured items (except those made for BRASO). Each project manager is responsible for specifying (or making sure it is specified) the preservation and packaging data for materials under his control. The exceptions would be equipment systems wherein an MRR has been prepared as part of the technical data requirements and special data or shipping containers specified by the Engineering Department.

(c) NAEC Supply Department.

(1) Materials Branch specifies packing of all in-house manufactured items.

(2) Buying and Ordering Branch of Purchase Division reviews all Purchase Requests to assure Preservation and Packaging information is included, but they do not vouch to the technical accuracy of the process.

(3) Contract Administration Branch utilizes preservation and packaging information from Purchase Division to incorporate it into or up date contract requirements.

(d) NAEC Quality Assurance Department. Preservation and Packaging Procedures utilized by contractors are checked by Quality Assurance personnel when necessary. However, routine inspections of methods required by contract are made by DCAS Inspectors at the contractors plant.

The Industrial Department Inspection assures that preservation is accomplished as specified on the in-house (Industrial Department) manufacturing orders.

(e) Branch Aviation Supply Office. BRASO specifies the Preservation and Packaging Procedures of all material under their cognizance; this is accomplished by their own Technical Packaging Group with special technical inputs (drawings, MPR's etc.) from NAEC Engineering.

BRASO maintains History Cards (BRASO Form 17-Rev. 3-65) which indicate the level of Preservation and Packaging for each component; Level "A" (MIL-STD-794) is prescribed for preservation, packaging; packing all parts (Reference 4). Where Level "B" packing is prescribed for intercontinental storage it is repacked to Level "A" prior to shipping overseas from storage depot.

(f) Engineering Specifications and Standards Department. This department has cognizance of writing and maintaining certain military specifications and is responsible for their conformance of format and content. Part of this scope of responsibility is to maintain surveillance of Section 5 and 6 (packaging and shipping instructions) of these specifications.

b. Field Surveys.

(1) NAVSEC, Washington, D.C. The NAVSEC Headquarters Command maintains cognizance of NAVSHIPSYSCOM material that interfaces with NAEC catapult systems (Reference 2). NAVSEC supports a Packaging and Container group in the Non-Metallic Materials Section, Materials Development and Application Office; this group is technically oriented to determine the specific methods required for preserving and packaging their equipment and components in accordance with Mil Spec procedures. They maintain contact with many supply sources (manufacturers, vendors or other agencies) and specify the proper preservation and packaging methods to be used and also evaluate new materials to improve these methods.

(2) NAEC, Tech. Field Office-Responsibility. The personnel of this office, provide an operational support function related to the maintenance and operation of the shipboard launcher and recovery equipment under NAEC cognizance In their daily operation they draw components and equipment from the supply system for replacement and installation of defective parts in shipboard catapults.

(a) NAEC Tech. Field Offices Surveyed. A personal visit was conducted to the NAEC Field Office at Norfolk Naval Base, Portsmouth, Va. to discuss with cognizant personnel their immediate experiences relative to the effectiveness of the preservation and packaging of components received from supply. During the course of the visit a meeting was arranged with ship personnel aboard the USS INDEPENDENCE (CV -62) to discuss with them their related experiences found aboard ship. In addition phone conversations were completed with cognizant field personnel at Mayport, Fla., San Diego, and San Francisco, Calif. Naval Bases relative to their experiences of a similar nature.

c. Defective Component Reports. A series of defective component reports (Appendix F) received from field personnel were collected for detailed investigation. These reports pertained to components which were found at various field supply locations and were reported to be corroding due to improper protection or preservation.

d. Literature and Materials Search.

(1) Government Agencies Contacted. A selected group of military agencies were contacted to obtain information on the scope of their current investigations into preservation and packaging of metallic parts (Appendix A). These

agencies support their own packaging laboratories which specialize in researching new materials and techniques related to corrosion prevention of military equipment.

(2) A systematic literature search was pursued to determine if any new packaging materials or processes were available in the commercial field, as well as the military, which were applicable to product preservation in the shipment and storage of launcher and recovery systems components.

The search included the many commercial resources of the public library for trade journals, technical indicies, etc. (Appendix B). For military report data the NAEC library was utilized where the annual index (Appendix B) of the defense documentation center was the principal source used.

The investigation included a study of the principle military packaging specifications (Chart III) listed in the "Military Packaging Reference Guide" (Appendix A) published by the joint Military Packaging Training Center, Aberdeen, Md.

(3) A search was initiated for new packaging materials and processes. Manufacturers indicies, such as; Thomas Register, Catalogs, monthly Publications, etc. were searched for companies (Appendix G) who manufactured protective coatings with particular emphasis on new or improved strippable materials.

2. Corrosion Control of Catapult Pneumatic System.

a. Pneumatic System Investigation.

(1) Reviewed and analysed technical data (schematic diagrams, manuals, drawings, etc.) for background information on operation of pneumatic system.

(2) Surveys. Had technical discussions on pneumatic system design parameters with NAEC engineering personnel and discussed pneumatic system operational procedures and maintenance problems with NAEC technical field personnel. Conducted an investigation on the operation of the high pressure air system used aboard ship with NAVSECPHIL engineering personnel and ship personnel aboard ship (CV 62).

(3) Component analysis. Analysed components (air flask, accumulators etc.) to determine feasibility of providing corrosion resistant coatings, (organic and inorganic) to surfaces subject to corrosive mediums.

b. Literature and Materials Search. Libraries were utilized as data sources to obtain lists of trade journals, society publications, technical handbooks,

specifications, etc. related to corrosion control. Conducted a search with pneumatic equipment manufacturers for technical data on equipment to promote and maintain dry air in pneumatic systems. Contacted coating (organic and inorganic) manufacturers who specialize in coatings to prevent corrosion.

C. DISCUSSION AND RESULTS.

1. Scope of Preservation and Packaging Study.

a. Responsibility for Procedures. The study was conducted to examine the overall design procedure utilized at NAEC for the Preservation and Packaging of launcher and recovery systems components. Consequently, essential to the investigation was the method used to evaluate an item from the initial packaging design phase through its application, and subsequent delivery to the ultimate user. Therefore, all cognizant NAEC departments were surveyed to determine the scope of their delegated responsibility (Paragraph B.1.2) and methods used to accomplish their tasks.

The initial authority for the Preservation and Packaging determination of launcher and recovery equipment is the delegated responsibility of separate Commands, depending on the material category. The NAEC Industrial and Supply Departments are responsible for new or overhaul items and the Branch Aviation Supply Office is responsible for spare and provisioned items.

The basic Preservation and Packaging Procedures for NAEC material is outlined in NAEC Instructions 4030-1D (Reference 3) as issued by NAEC Commanding Officer dated 16 Nov. 1970 and establishes policies for preservation, packaging and packing of material at NAEC.

The basic preservation and packaging procedures for the Branch Aviation Supply Office material is outlined in separate instructions issued by the Branch Aviation Supply Office, Officer-in-Charge which are instructions similar to those indicated (Reference 4). The instructions specify that Level "A" protection per MIL-STD-794 be used for their materiel.

These sources of supply of components coordinate their efforts, where applicable, in delivering these items for fleet use.

Further implementation of these packaging design efforts requires the cooperation of the NAEC Supply Department, Quality Assurance Department and the Fleet Services Department. These departments have the associated responsibilities of supplying the finished packaged unit, inspecting the finished packaged unit or reporting on the finished packaged unit from field users.

Although the NAEC Engineering Department provides technical support to other NAEC departments when specified, for these Preservation and Packaging Procedures, no separate group is designated within the Launcher and Recovery Design Group to be responsible for designing special packaging or containers; maintaining a current knowledge in preservation and packaging technology including ship board logistics of their respective components.

The Branch Aviation Supply Office maintains a current knowledge in the latest packaging techniques applicable to their supply items. However, they do not receive field reports (Appendix E) on packaging problems directly and must depend on receiving this information in an indirect manner.

The packaging techniques utilized by the Industrial Department rely on the current methods defined in MIL-P-116 in conjunction with time proven materials. They do not investigate new materials for updating procedures; they do not identify parts as critical in their marking of the packaged component.

b. Preservation and Packaging Procedures Specified. All interrelated procedures in the preservation and packaging of an item are important to obtain a satisfactory package. However, the emphasis of this investigation was directed to the level of protection and the type of preservative specified for these components. The reason for these specific considerations was due to the problems cited in the field reports on defective components (Appendix F) which implied inadequate packaging and preservation was utilized and allowed the parts to corrode.

Within the various departments are competent technical personnel who are capable of determining the proper preservation and packaging to provide protection of the units in a marine environment. During the course of the study it was found that the preservation and packaging as specified for the defective components investigated was adequate and initially called for the level (Level "A" per MIL-STD-794) of protection needed. In some instances Level "B" packing is designated for continental shipping of an item but it is repacked to Level "A" prior to shipping overseas from the depot.

(1) Level "A" Requisites (MIL-STD-794). This is the degree of protection against the most severe conditions known or anticipated to be encountered during shipment, handling and storage. Level "A" preservation and packaging and Level "A" packing requires protection against direct exposure to all extremes of climatic, terrain, operational, and transportation environments. The conditions to be considered include, but are not limited to:

(a) Multiple rough handling during transportation and in-transit storage from manufacture to ultimate user.

(b) Shock, vibration, and static loading during shipment, including deck shiploading and offshore or over-the-beach discharge, to ultimate user.

(c) Environmental exposure during transit where port and warehouse facilities are limited or nonexistent.

(d) Extended unimproved open storage in all climatic zones, particularly while under static loads imposed by stacking.

(e) Special package and pack features for field and combat operations (handling and utility).

(f) Special features as required by combat development agencies.

It is evident from these conditions stated, that all launcher and recovery systems components, due to their ultimate storage environment should be protected to Level "A". In addition it is essential that the methods necessary to obtain this level be determined by competent packaging specialists who are knowledgeable in the use of the applicable specifications (Reference 6) and related charts (Appendix C).

(2) Preservatives. The type of preservative to be used is normally specified in the procurement document and conforms to MIL-P-116, Chart 1 requirements, unless otherwise specified.

Most of the parts examined (see Chart IV) for this study were protected with one of these standard preservatives which normally provide adequate corrosion protection. However, these preservatives, due to their color (black or brown per MIL-C-16173) do not permit visual inspection for corroded surfaces without the removal of some or all of the preservative from the part, and thus expose the part to the surrounding corrosive environment.

An important consideration of this study was the investigation of strippable compounds (similar to MIL-P-149) to be used for corrosion protection of components. These can be used in lieu of the petroleum based (similar to MIL-C-16173) preservatives and permit visual inspection (inspect for corrosion) without exposing part to surrounding hostile environment. These strippable coatings (MIL-C-3254, MIL-C-6799, etc.) are available with rust inhibitors incorporated in them and many can be sprayed as well as dipped.

(3) Marking. All unit, intermediate and shipping containers shall be marked in accordance with MIL-STD-129 (as per MIL-STD-794). This refers to normal marking information (Part No., Stock No., Contract No. etc.) but any specialized handling information (such as, "critical item" etc.) requires that it be specified for each individual component as required. Since a significant number of Launcher and Recovery System components are considered critical, high value items, a greater use of indicating the critical nature of each part should be effected with a special marking note applied on the package (also unit and intermediate).

c. Field Control Procedures. Equally important to the proper methods specified for the preservation and packaging procedures is the effectiveness in the follow up to assure the procedures are properly implemented.

To control the implementation of the procedures requires the precise, coordinated flow of information and inspection by all associated activities (NAEC Quality Assurance, NAEC Industrial Inspection and DCASR). Any breakdown of this cooperative effort can result in delivering improper or inadequate preserved and packaged parts to the ultimate user.

(1) Initially new manufactured parts are inspected by NAEC Industrial Department if made by them, or by DCASR Inspection if part is made at a Contractors' plant. Consequently, these two inspection sources are responsible for determining if the preservation and packaging of the item prior to shipment meets the methods specified by the original packaging specialists. If the method is not expressly detailed, such as; type of cleaning, preservative, etc., to protect the item to the required ultimate level, an inspection can not satisfactorily be accomplished. Therefore, it is not sufficient to indicate only "Package to Level "A", but rather the detailed methods specified in MIL-P-116 must be listed on the manufacturing order form, specification, or contract which is to be used by the appropriate inspector.

(2) The NAEC Quality Assurance Department initially certifies a contractor's manufacturing facility to assure the overall manufacturing capability. This is accomplished by their field personnel who check the facility and its inspection section at the source of manufacture prior to contract award. An integral part of this preaward inspection is the availability of adequate preservation and packaging skill.

As a part of their daily operation NAEC Quality Assurance personnel receive and review copies of reports on defective components (some concern packaging discrepancies) found in the field and which they fully investigate.

In conjunction with this report surveillance the Quality Assurance personnel utilize the following report forms.

(a) Fast Action Discrepancy Report (Appendix E). This report system (FADR) uses two forms. One, NAEC 13800/4 is available to field personnel to report receipt of defective material (includes preservation and packaging problems) to NAEC Quality Assurance Department, and the other form, NAEC 13820/3A, is the reply form used by Quality Assurance personnel to advise sender the course of action taken to the initial inquiry. It provides for a fast solution to field problems on defective materials.

(b) Request for Salvage Action (Appendix E). This report form, NAEC 4855/10A, is use by Quality Assurance personnel to report defective materials found in the field or at manufacturing sources and to notify cognizant activity (NAEC).

(c) Request for Engineering Information (Appendix E). This report form, NAEC 3900/7, is used by NAEC personnel (Quality Assurance) to obtain from NAEC Engineering information or advice about material.

(3) All non-conformance material which is found in the field (either in supply depot or aboard ship) by NAEC Field Technicians is reported to NAEC via Fleet Services personnel for disposition or corrective action. This is accomplished by use of one of the following report forms:

(a) Letter Form. This report uses no formal format other than a letter form (Appendix E). It is used to report and discuss various material problems which occur in the field.

(b) Arresting Gear Field Technical Report (Appendix E). This report form, NAEC 2104, is used by field technicians to report discrepancies of arresting gear equipment and components found in the field. It currently does not contain a line for preservation and packaging problems.

(c) Steam Catapult Field Technical Report (Appendix E). This report form, NAEC 13810/5, is used by field technicians to report discrepancies of catapult equipment and components found in the field. It currently does not contain a line for preservation and packaging problems.

All of these previously cited report forms are NAEC oriented with copies directed to various NAEC Departments for response. However, BRASO, which supplies spare parts for the Launcher and Recovery equipment do not receive these reports directly, particularly on problems dealing with preservation and packaging. Consequently they are not aware of defected parts due to preservation and packaging that occur in the field unless advised by a secondary source and thus may not be alerted to change their packaging procedure if necessary.

d. Field Survey Disclosures. The field surveys conducted were limited in scope to the immediate technical objectives of this preservation and packaging study. Consequently, these surveys were brief, but at the same time concise enough to obtain some pertinent data as an indication for improvements in NAEC preservation and packaging procedures.

(1) NAVSEC, Washington, D.C. A meeting was concluded with the section supervisor of the packaging and container unit who is responsible for the preservation and packaging of NAVSEC cognizant material. During the course of the discussion he mentioned a new strippable material which was presently being evaluated for its effectiveness to prevent corrosion of ship's propellers while in storage; it had been tested in a marine environment for almost a year with complete success. He also cited an improved hot dip strippable material which they evaluated and found to be more reliable in the prevention of corrosion of metal parts containing copper and zinc.

All the data related to these materials was obtained for NAEC evaluation (Chart II).

For NAVSEC to implement the immediate use of such a new material an interim form is issued, known as, "NAVSHIPS Notice". This form provides for all the information about the material and its application and listed in NAVSHIPS manual 0900-028-3010. This data is then incorporated into the appropriate Mil specification.

(2) NAEC Tech. Field Offices. The limited field survey was conducted to determine the effectiveness, at the users level, of the current preservation and packaging procedures in effect. This survey included talking directly with personnel in the supply depot at the Norfolk Naval Base, the cognizant field technical representatives and the catapult and arresting gear personnel stationed aboard the USS INDEPENDENCE (CV 62) which was being overhauled at the Norfolk Naval Base, Portsmouth, Va.

All of the personnel contacted were experienced in handling packaged launcher and recovery systems components directly from supply (either depot or ship) and consequently, could make a significant judgement of the effectiveness of the procedures in use. Indications from the discussions with these people were that the incident of receiving corroded parts from supply was minimal (less than 5%). However, it was a general consensus of opinion among them that incomplete or inadequate identification and markings (incomplete part no., part name not readable, etc.) on the package was a more prevalent supply problem.

Consequently the incompletely marked package unit is opened for inspection and identification purposes then, if not used, reclosed, but not necessarily conforming to the proper packaged procedure specified, and returned to storage. Similar experiences were reiterated by the field technical representatives stationed at Mayport, Fla., San Diego and San Francisco, Calif., Naval Bases.

Another problem cited was the bulk of some wood crate packing of components which prevented acceptable stowage aboard ship due to insufficient clearance in the designated storage area. Consequently, in order to store the unit the wood crating was removed; if the inner packaging was not designed for this type of handling it became damaged and torn with the subsequent loss of effective protection against ship board corrosive environments.

e. Analysis of Field Reports for Defective Components (Appendix F). A detailed analysis was made of the following components which were reported as being corroded due to inadequate preservation and packaging. These items were the subject of various field reports and lack specific data in many instances to make conclusive analysis.

The items were checked with their NAEC detailed drawing, MPR, and BRASO History Card (Appendix F) to determine if the initial packaging specified was adequate. Notations were made for each item investigated (Chart IV).

(1) Detailed Analysis. Item 1 - Barricade (P/N 614148-1 NAEC Field Report (Appendix F-1) revealed corrosion of metal rings and mildew of nylon webbing when crate was opened aboard ship. Barricade was originally packaged as prescribed by BRASO history card (BRASO Form 17) instructions for a Method IA type MIL-P-116 Packaging. Investigation indicated the corrosion was due to occluded moisture in the nylon and was entrapped in the original packaging. Action Taken - Future shipments of Barricades will be packaged in accordance with NAEC, MPR 1290 which specifies a MIL-P-116 Method II Type packaging with an active desiccant to absorb any occluded moisture.

Item 2 - Tension Bars/Release Element (MIL-T-23426A) NAEC Field report revealed units badly corroded when container direct from supply was opened aboard ship (Appendix F-2). These bars were apparently repackaged in response to a request for a large quantity (200) without following the packaging procedure specified by the existing ASO instruction No. 12152. (See Appendix F-2.) These instructions are incorporated into the commodity specification MIL-T-23426 as Amendment 1 (see Appendix F-2). This commodity specification lists the bars by part number and specifies how they should be preserved and packaged (Section 5) for transportation and storage. Included in this specification are:

		MODEL A/C
IRM-1720-866-7019 (P/N 413745)	Tension Bars/ Release Elements	F-8
IRM-1720-073-1243 (P/N 506996)	Tension Bars/ Release Elements	A-5
IRM-1720-572-7532 (P/N 502822)	Tension Bars/ Release Elements	N.S.
IRM-1720-869-5453 (P/N 128 CVM-10500)	Tension Bars/ Release Elements	C-2, E-2, A-6
IRM-1720-919-2140 (P/N 508713)	Tension Bars/ Release Elements	A-3

These above units were included as items for investigation, however, the commodity specification (MIL-T-23426) covers the preservation and packaging procedures of all tension bars/release elements used with launch aircraft.

Action Taken - Since these items are categorized as critical (Appendix F-2) for functional application it is mandatory that they be preserved and packaged at Level "A" only. Consequently, to insure this Level "A" is at all times adhered to throughout the packaging and/or repackaging procedure Amendment 2, MIL-T-23436 (Appendix F-2) was written. This information is to be in-

corporated into Section 5 of MIL-T-23436, by personnel, code 91124 , Aircraft Section, Aircraft Weapons and Ship Division, NAEC, who are currently revising this specification.

Item 3 - Lever (P/N 501549-7) NAEC, Request for Salvage Action (Form 4ND and NAEC 4855/10A) (Appendix F-3) indicated part had "severe rust on all surfaces"; no information on whether part was packaged and opened or other conditions in which it was stored.

Action Taken - No plating or protective finish indicated on NAEC 501549-1 Dwg. initial preservation (MIL-C-16173 GR 2) and packaging specified for the part was checked on BRASO History Card (Appendix F-3) and found it called for Level "A" packaging in accordance with MIL-P-116 Method I-A14 which is a carton, heat sealed vapor barrier (MIL-B-131), then an additional carton. This procedure provides for long term storage in a marine environment until package is opened.

Item 4 - Union Nut (P/N 414240-1) NAEC Request for Salvage Action (Appendix F-4) states parts have "first stage of rust" due to no preservative, no information on condition of packaging or its stored state.

Action Taken - Investigated part drawing 414240-1 which does not call for any plating or protective finish. Initial responsibility for preservation and packaging of item is Defense Industrial Supply Center which has cognizance of this type of hardware items. NAEC should plate part.

Item 5 - Inner Race (P/N C87780-47) NAEC Request for Salvage Action (Appendix F-5) indicates "first stage of rust all surfaces" due to inadequate preservation; no information on type or condition of packaging as stored.

Action Taken - Investigated part drawing C87780-47 which refers to MPR 1262 (Reference 8) for initial preservation procedure. Further check of History Card (Appendix F-5) calls for Level "A" preservation and packaging as per MPR 1262 (Reference 8) as well as nailed wood box. Packaging is adequate for long term storage until opened.

Item 6 - Sheave Sub-Ass'y (P/N 509185-3). NAEC Request for Salvage Action (Appendix F-6) states that there is "severe rust throughout the entire surface" of the part and it is badly damaged from handling since it was stored in an unpackaged condition.

Action Taken - Part drawing 509185-3 was checked but did not indicate any preservation data. Further investigation of BRASO History Card (Appendix F-6) indicated part was initially to be preserved and packaged to Level "A" in accordance with MPR 1262 (Reference 8) and then packed in nailed wood box. This packaging procedure should provide for long term storage protection.

Item 7 - Spacers (P/N 53-40112-2). NAEC Request for Salvage Action (Appendix F-7) indicates that "all pieces are in first stage of rust". No information on type of packaging as stored.

Action Taken - Checked part drawing 53-40112-2; no protective plating or coating indicated. Investigated BRASO History Card for part (Appendix F-7) which called for Level "A" preservation and packaging per MIL-P-116 Method IA-8 which call for preservation (MIL-C-16173 GR 2) and packaged in a heat sealed water vapor barrier bag. This packaging procedure should provide for long term marine storage.

Item 8 - Cable (P/N 29-40707-775). NAEC Request for Salvage Action (Appendix F-8) states that items were "in first stage of rust" and that no preservation of the material was apparent. No other packaging information available.

Action Taken - Investigated part drawing 29-40707 and found no notations for preservation or protective coating of part. Checked BRASO History Cards (Appendix F-8) which initially called for Level "A" packaging with preservative (MIL-C-16173 GR 1) on cable as well as fittings and wrapped with barrier material. This packaging is inadequate for long term marine storage. A new packaging technique (Appendix D-2) is now available which will provide longer storage capability and will be specified on all future packaging of this item.

Item 9 - Sleeve (P/N 408402-1). NAEC Request for Salvage Action (Appendix F-9) indicates item has "second degree rust on all surfaces not plated" but no information on type packaging other than "absence of preservation".

Action Taken - Investigation of part drawing 408402 indicated no notes specifying plating or preservation. Review of BRASO History Cards initially specify preservation (MIL-C-16173 GR 2) and wrap in waterproof barrier paper per MIL-B-121A then packed in fiber board container per Fed PPP-B-636 Type II Class 2 and over packed in a nailed box. Recommend that due to high value and critical nature of item it be preserved (MIL-C-16173 GR 2) and packaged in vapor proof heat sealable bag per MIL-B-131 and then put in carton per latest Fed PPP-B-636 Type SF Class-Weather Resistant, then over pack in nailed wood box.

Item 10 - Cable (P/N A92791-27-1750; -13-600). NAEC Request for Salvage Action (Appendix F-10) states that units are "in first stage of rusting" due to lack of preservation materials.

Action Taken - Check part number drawing A92791 which calls for uncoated material. Review of BRASO History Cards show initial requirement for preservation per MIL-C-16173 GR 1 then over wrap with barrier material per MIL-B-121 and then wood sheath. This is similar procedure as Item 8 and will be packaged in the future by new technique (Appendix F-10) which will provide long term storage capability.

Item 11 - Track Section (P/N 408084-2; -3). NAEC Request for Salvage Action (Appendix F-11) states that protective coating is "peeling off and pieces are rusting". No information on packaging of parts as stored.

Action Taken - Checked part drawing 408084 and found no notes for protective finish. Review BRASO History Cards which initially specified preservation (MIL-C-16173 GR 2) and Method IA-15 per MIL-P-116 for packaging. This method requires a carton and heat sealed vapor proof bag to provide corrosion protection. These parts to be superceded by parts 512513 on future procurements and will have Level "A" packaging specified for their protection.

Item 12 - Socket Eye End (400790-1). NAEC Request for Salvage Action (Appendix F-12) indicates that item had "heavy rust" on some surfaces. No information on the type of packaging as stored.

Action Taken - Checked part drawing 400790 and notes call for cadmium plating. Review of BRASO History Cards initially specified preservation (MIL-C-16173 GR 2) and grease proof wrap per MIL-B-121 then crated. Recommend due to high value and critical nature of part that heat sealed vapor proof bag per MIL-B-131 replace barrier wrap MIL-B-121.

Item 13 - Inner Spacer (P/N 71-40212-2). NAEC Request for Salvage Action (Appendix F-13) states that items are in "first stage of rusting" due to improper packaging and preservative.

Action Taken - Checked part drawing 71-40212 and found no notation indicating any preservation or protective coating. Review of BRASO History Cards (Appendix F-13) indicated items are to be preserved (MIL-C-16173 GR 2) and packaged to Level "A" protection in accordance with MIL-P-116 Method IA-8 which requires a heat sealed vapor-proof bag and then packed in nailed wood box. This packaging should provide long term marine storage.

Item 14 - Clevis Pin (P/N 317434-1). NAEC Request for Salvage Action (Appendix F-14) states that items are not preserved and are "rusty over entire part".

Action Taken - Check part drawing 317434 and found no notation calling for preservation or protective coating. Review of BRASO History Card (Appendix F-14) calls for packaging item per MIL-P-116 Method IC-2 which requires part to be preserved (MIL-C-16173 GR 2) and wrapped in waterproof barrier material then packed in weather resistant carton. Recommend procedure to use heat sealed vaporproof bag in future. Part no longer in BRASO inventory, and now is responsibility of Defense Industrial Supply Center. NAEC should plate part.

Item 15 - Piston Rod (P/N 504130). The only information on this item was a Photo (Appendix F-15) taken aboard the USS CORAL SEA (Feb. 66) showing the extent of the rust pitting on the surface of the shaft. This apparently was evident when the exterior crating was opened and the barrier material removed. No other information was available.

Action Taken - Checked part drawing 504130 and found no notations for preservation or protective coating. Review BRASO History Cards (Appendix F-15) indicates that preservation (MIL-C-16173 GR 2) and packaging was to be Level "A" protection in accordance with MIL-P-116 Method IA. No specified submethod is indicated. Future Action - Since item is a critical high value part more complete instructions for packaging should be given with the consideration of more positive protection of the surface from marine moisture vapor corrosion. It should detail the type of barrier material (such as MIL-B-131 vapor proof) and possibly a strippable (hot or cold) compound should be applied over the bare metal prior to barrier material. Then inspection (visual) could be made of the part after unwrapping the barrier material without exposing it to moisture laden environment.

Item 16 - Cap Assembly (P/N 504047-1). NAEC Request for Salvage Action (Appendix F-16) indicates parts have "rusted areas" and certain areas are painted. PHOTO (Appendix F-16) shows exposed surfaces extremely rusted. No information on preservation and packaging.

Action Taken - Checked part drawing 504047-1 and found no notations for preservation or protective coating. Review of BRASO History Card (Appendix F-16) calls for application of preservative (MIL-C-16173 GR 2) and wrapping with barrier material per MIL-B-121 then crated in nailed wood box.

Future Action - Item is a high value critical part, therefore, consideration should be given to preserve then place dessicant in cavity to absorb any occluded moisture, then wrap or bag item with vapor proof barrier material per MIL-B-131 then crate in nailed wood box with skids. Notation on marking should specify that if part is opened for inspection it should be represerved and repackaged to Level "A" protection in accordance with original packaging method.

Item 17 - Strap Assembly (P/N 50482-1; -3). No Field or Salvage Reports are available for this item (Appendix F-17), consequently, any packaging deficiencies which may have occurred in the field are unknown at this time.

Action Taken - Checked drawing of part 504821 and found no notations for preservation or protective coatings. Review of BRASO History Card (Appendix F-17) calls for Level "A" protection in accordance with MPR 1283 (Reference 8). This procedure calls for preserve (MIL-G-23827) barrier material wrap (MIL-B-121) then placed in heat sealed vapor proof bag (MIL-B-131) with dessicant (MIL-D-3464) and entire unit placed in a nailed wood box. This method should protect item for long term marine storage.

Future Action - Since this is a high value, critical part consideration should be given towards packaging it in the new method used for cable assemblies (Appendix F-17) and eliminate the hazard of puncturing the barrier materials during the packaging and handling procedures.

Item 18 - Valve (P/N 509979-1). No Field or Salvage Reports are available for this item (Appendix F-18), consequently, any packaging deficiencies which may have occurred in the field are unknown at this time.

Action Taken - Checked drawing of part 509979 and found no notations for preservation or protective coatings. Review of BRASO History Card (Appendix F-18) calls for preservation and packaging to Level "A" protection per MIL-STD-794.

Future Action - Since this is a vendor purchased part and no specific method of MIL-P-116 is mentioned it will require the vendor to package at their interpretation of Level "A" requirements unless more detail is specified in vendor's contract. Consequently, the packaging effectiveness is dependent upon the vendor's expertise on packaging. Therefore, consideration should be given to having the BRASO packaging specialist specify the method of packaging per MIL-P-116.

Item 19 - Piston Assembly (P/N 613101-7). No Field or Salvage Reports are available for this item (Appendix F-19), consequently, any packaging deficiencies which may have occurred in the field are unknown at this time.

Action Taken - Checked drawing of part 613103 and found no notations for preservation or protective coating. Review of BRASO History Card (Appendix F-19) calls for part to be preserved (MIL-C-16173 GR 2) per MIL-P-116 procedure and then wrapped with barrier material per MIL-B-121 and packed in nailed wood sheathed crate per MIL-C-104.

Future Action - Consideration should be given to using vapor proof barrier material per MIL-B-131 in lieu of water proof barrier material per MIL-B-121.

Item 20 - Piston Assembly (P/N 613102-13). No Field or Salvage Reports are available for this item (Appendix F-19), consequently, any packaging deficiencies which may have occurred in the field are unknown at this time.

Action Taken - Checked drawing of part 613102-13 and found no notations for preservation or protective coating. Review of BRASO History Card (Appendix F-20) calls for part to be preserved (MIL-C-16173 GR 2) and packaged to Level "A" protection and wrap with barrier material (MIL-B-121) per MIL-P-116 and then packed in nailed wood sheath crate per MIL-C-104.

Future Action - Consideration should be given to using vapor proof barrier material per MIL-B-131 in lieu of water proof barrier material per MIL-B-121.

Item 21 - Sealing Strips (P/N 613380-2; -3). No Field or Salvage Reports are available for this item (Appendix F-21), consequently, any packaging deficiencies which may have occurred in the field are unknown at this time.

Action Taken - Checked drawing for part 613380 which specifies method to preserve (Type P-2, MIL-P-116) and package item incorporated in the drawing notes. It calls for preservation per MIL-P-116 and method of wrapping with vapor proof barrier material per MIL-B-131 and over wrap with cotton duck per CCC-C-428. The procedure includes special method to physically protect item. Review of BRASO History Card (Appendix F-21) indicates to refer to drawing 613380 for preservation and packaging instructions.

f. Literature and Materials Search - Scope. The following is the scope of the literature and materials search which was conducted during the preservation and packaging study.

(1) Commercial. Public library sources were researched to obtain the names of all trade journals which specialized in commercial packaging, materials and equipment. These trade journals (Appendix B) were contacted and copies of their current indices were solicited. Some responded to the request (Appendix B), but a brief examination of these indices received did not reveal any applicable techniques for immediate military use (Appendix D).

Another source of data was the Engineering Index (1970) Vol. 69 (Appendix B) which lists reports on new packaging materials and techniques from world wide sources. Many of these reports covered pertinent subjects, but project priorities precluded obtaining copies for this study.

(2) Military. The NAEC library was utilized in researching sources for military packaging reports. The principle source available was the Technical Abstract Bulletins, Annual Index for 1970 issued by Defense Documentation Center. A few reports were requested (Appendix B) from this source, but they did not reveal any applicable data. Requests were sent for a bibliography on packaging, but no reply was received in time to be included in this report.

(3) Military specifications (Chart III). The basic military specifications utilized as information reference sources were the following:

(a) MIL-STD-794, Procedures for Packaging and Packing of Parts and Equipment. This standard provides the overall packaging requirements and tasks required to accomplish the packaging of parts and equipment based on

their material composition, criticalness of surface finish, compatibility with preservative and on such physical factors as; size, weight, fragility, and environmental severity of shipment, handling and storage (Appendix C).

This standard is to be used in developing preservation, packaging and packing requirements of parts and equipment. It is also used to assist in developing Section 5 of MIL Commodity Specifications (unit design) as well as preparing packaging requirements cited in contracts. Reference MIL specifications are listed to supplement the design requirements. In lieu of a specific MIL Commodity Specification or process specification, Section 4 and 5 of this standard shall govern.

(b) MIL-P-116 Methods of Preservation. This specification is the basic MIL-Specification covering the requirements for cleaning, preservation and packaging of items, equipment and materials for protection against corrosion, physical damage and other forms of deterioration during handling, shipment and storage.

It also provides test procedures used to verify the requirements and cites all related reference specifications (Appendix C).

(c) MIL-STD-726, Packaging Requirement Code. This standard establishes and defines a system for "coding" essential preservation and packaging data embracing the requirements established in MIL-STD-194, MIL-P-116 and related specifications.

In utilizing this code lengthy identifying and descriptive data is reduced to a convenient form for electronic data processing methods for use in procurement or logistic purposes.

(d) MIL-Commodity Specifications (Reference 6). Specialized equipment and components require a separate design specification which establishes the specified design parameters. The format of this type of MIL specification provides for special preservation and packaging data to be included in Sections 5 and 6 of the specification.

With the use of these basic MIL specifications and related references the package designer or specialist is able to specify adequate preservation and packaging of normal military components. These documents provide three (3) levels of environmental protection, 27 basic methods of preservation (plus many specialized submethods) and a myriad of techniques for cushioning and containerization of parts. Consequently it requires the expertise of a technically qualified specialist to interpret and specify the proper methods, and work in conjunction with the design engineer for any specialized technical requirements.

(4) Government Agencies' Responses (Appendix A). The following responses were received from the various Government agencies contacted through correspondence.

(a) Directorate of Packaging
AFLC (DSP)
Wright-Patterson AFB
Dayton, Ohio 45433

Response from this agency indicated the Materials Division of the Air Force Packaging Evaluation Agency are currently investigating various water vapor barriers for corrosion protection and are deeply involved in polyurethane foam-in place packaging techniques (Appendix A).

(b) US Army Natick Laboratories
Natick, Mass. 01760

Their Packaging Division is currently evaluating some urethane foam-in-place packaging materials and have done some other research with plastic films (Appendix A). They recently sponsored a joint symposium on military packaging for military agencies only.

(c) Department of the Army
HQ Tobyhanna Army Depot
Tobyhanna, Pa. 18466

The AMC Packaging, Storage and Containerization Center investigates new preservation and packaging materials (Appendix A).

(d) Department of the Army
Joint Military Packaging Training Center
Aberdeen Proving Ground, Maryland

Correspondance with this agency did not receive a reply other than copies of booklet 100, Reference Guide to Military Packaging (Appendix A). This agency operates a military packaging school to train packaging specialists.

(5) New Material Sources. The search was confined to companies who manufacture strippable protective coatings or preservatives. A number of speciality manufacturers who make these type coatings were contacted by phone or letter (Appendix G). Responses were received in the form of product data sheets (Appendix K) and physical samples of the material. These samples were forwarded to NAEC for their evaluation on future applications (Chart II).

2. Scope of Corrosion Control of Catapult Pneumatic System Study.

a. Pneumatic System Analyses for Corrosion Protection. An analysis of the pneumatic system indicated that it operates as a closed system after the air flasks are fully pressurized (Figure 3). Consequently, if any moisture laden air is introduced into the system it will remain entrapped until system is purged with dry air. If this moisture is retained in the system corrosion will develop in the various components not protected by corrosion resistant coated surfaces (plating, sprayed metal or organic coatings).

A design study of the NAEC drawings (Reference 12) for the major components (air flask, accumulators, cylinders, etc.) revealed that none of these units were provided with corrosion resistant surfaces (not plated, coated, etc.) and consequently would rust if allowed to remain in a moisture laden environment.

The study further disclosed that to prevent corrosion of these components in a moisture laden environment required incorporation of methods either to prevent moisture from initially becoming entrapped in the pneumatic system or to provide a corrosion resistant coating (plating, organic coating, etc.) on the exposed surfaces of the components. The feasibility of each approach was investigated during the course of this study.

b. Moisture Accumulated within Air System During Operation. The pneumatic system for the catapult is located principally on the ship's 03 deck in the catapult machinery room (Figure 6) which is exposed to a marine atmosphere. The compressed air (3000 PSI) supplied to the system is received from the ship's high pressure air supply at this juncture (Figure 3). However, this high pressure air system is supplied from the ship's compressor (Reference 9) located on the hold deck (Figure 7). Consequently, the air as received at the catapult air flask is delivered, via 3/8 pipe, hundreds of feet from the initial source at the compressed air dehydrator (Reference 10) adjacent to the main compressor source (Figure 7). This extended travel of the high pressure compressed air flow between initial supply and final use is subjected to many factors (many intermediate tap-off lines, joint leakage, temperature variations, etc.) which effects the efficiency of the system. Consequently, it will allow moisture and foreign particles to accumulate in the system if not properly maintained.

c. Survey of Operation of Catapult and HP Air System.

(1) Discussions with NAVSECPHILA engineering personnel confirmed the piping layout of the ships' HP air system and they further supplied the technical data (drawings, equipment manuals, etc.) necessary to evaluate the operational HP air flow of the system. Further discussions with NAEC engineering support the operational procedures (flow rates, time function, etc.) of the catapult pneumatic system in conjunction with this HP air system.

(2) NAEC Tech. Field Office, Portsmouth, Va. An inquiry was conducted with the field technicians relative to the operational problems they encounter with the pneumatic system in regard to entrapped moisture. During the course of their daily work with maintenance and overhaul on the catapult equipment they indicated that moisture laden air in the pneumatic system was a prevalent problem. This was due in part to the high pressure air supply from the ship's air compressor which delivered wet air they observed.

The NAEC field technicians suggested talking with the ship's personnel who controlled the ship's HP air compressor operations. Subsequent discussions with Division A personnel indicated that the air compressor was operated in conjunction with a compressed air dehydrator installed adjacent to it aboard ship (References 7 and 8). However on this particular ship investigated (CV 62), the dehydrator was not operating efficiently and allowed mositure laden high pressure air to be delivered to the catapult supply source; no official documentation (manuals, MRC cards, etc.) was utilized for maintenance purposes, but an experience procedural policy was followed. Phone surveys were concluded with other NAEC technical representatives at field locations at Mayport, Fla., San Diego and San Francisco, Calif. on their experiences with moisture accumulation in the compressed air system. They further reiterated that the quality of the air supplied from the ship's HP air system was generally moisture laden as received at the catapult pneumatic system source.

A more detailed investigation was requested of the NAEC Field Technicians (Mayport, Fla. and San Francisco, Calif.) to establish what maintenance procedures and documentation for the high pressure air system was utilized by the ship's personnel on the aircraft carriers currently in dock at their locations.

The NAEC field technician stationed at Mayport, Fla. contacted the Division A personnel aboard the CV 42 carrier to determine the maintenance procedures they used for the ship's high pressure air compressors and air dryers (dehydrators). He found the following conditions were currently in effect on this particular ship. The high pressure air dryers (dehydrators) used in conjunction with the ship's high pressure air (3000 PSI) compressors were inoperative and there was no formal maintenance procedure and documentation (manual, MRC cards etc.) available for the dryers. Consequently without the use of the dryers in the high pressure air system there was no way of preventing moisture from developing in the system prior to its connection at the supply source for the catapult pneumatic system (Figure 3).

The NAEC field technician stationed at San Francisco, Calif. contacted the Division A personnel aboard the CV 63 carrier which was currently in port there. He inquired as to what maintenance procedures were followed for their ship's high pressure (3000 PSI) air compressor and dryer (dehydrator) and found the following conditions currently in effect.

The ship has a new, recently installed high pressure air dryer (dehydrator), but currently there are no PMS procedures available for this newly installed equipment. These PMS procedures have been requested, but have not been received to date. There is an instruction manual available for this dryer equipment which appears to be adequate for operational use. However, no investigation was made as to how efficient the dryer operation was in preventing moisture from developing in the system where it supplied high pressure air to the catapult pneumatic system.

Since these shipboard investigations revealed inconsistancies in the maintenance procedures of the various carriers no firm analysis can be made as to the efficiency of the ship's high pressure air systems in supplying dry moisture free air to the catapult pneumatic system. Therefore, it will require a detailed test be completed of a ship's high pressure air system which has been properly maintained and deemed to be operating at its best efficiency. The test would involve operating the ship's high pressure air system (compressor, dryer etc.) at its normal output (GFM at 3000 PSI) and then analyze the quality of air being delivered to the air flask of the catapult pneumatic system.

If after completing this test it is determined that the high pressure air as delivered to the air flask still contains moisture then it will require auxiliary drying equipment to be installed at the air flask juncture to guarantee dry air for operating the catapult pneumatic system.

d. Feasibility of Installing Auxiliary Dryer Equipment for Corrosion Control.

(1) Moisture Prevention Methods. To control corrosion within the catapult pneumatic system requires the prevention or removal of any moisture within the system. The primary objective would be to prevent moisture from developing in the system and thus maintain a completely dry air. A secondary objective would be to utilize a method of periodically removing moisture automatically as it accumulates within the system. The use of an auxiliary dryer designed to remove moisture in the compressed air as supplied to the pneumatic system would satisfy the main objective, while the use of automatic moisture traps in conjunction with the catapult pneumatic system components would resolve the secondary objective.

(2) Dry Air Equipment Analysis. Dry air is a relative term and all atmospheric air contains some moisture in the form of water vapor depending upon the relative humidity of the air. Moisture in the form of vapor does no harm in compressed air systems, but when the vapor condenses then the resulting moisture causes corrosion of pipes and equipment; it also washes lubricant from operating equipment resulting in wear and damage and loss of efficiency in the operation of pneumatic components. Research shows that the compressor intercoolers will

remove on the average of 68% of moisture in the air and the proportion of the remainder which will condense in the piping system depends how far the piping extends, which in most distribution systems is considerable. There are basically three types of compressed air dryers available and they are usually installed in the distribution lines (piping) near the operating equipment. To provide for minimum maintenance automatic moisture traps are recommended for use with air dryers. The most important criterion in choosing an air dryer is the dew point which varies with pressure and temperature.

A search was made, using manufacturers indices (Thomas Reg'y, Trade Journals, etc.), for companies who manufactured high pressure pneumatic equipment and letters were written to these companies (Appendix L) for design data on their products. Many of these manufacturers respond with data (Appendix L) on their dryer equipment and it was analysed for its applicability to high pressure (3000 PSI) air systems. Two different types of dryers were considered either of which will operate on a minimum maintenance schedule and meet the preliminary design parameters of the system. Consultations were had with manufacturers representatives to discuss the feasibility of using their equipment and the recommended models which would be most efficent for the parameters specified.

(a) The first type of dryer chosen uses a refrigerant system to condense the moisture from the compressed air. This type dryer operates efficiently above 35° F ambient temperatures. It is relatively maintenance free and does not require any replacement materials (dessicants, filters, etc.).

(b) The second type dryer chosen uses a dessicant to remove moisture from the compressed air. It is a two chamber configuration which permits the air to dry thru one chamber while previous used dessicant in other chamber is being dried. This type dryer will produce atmospheric dew points as low as -100° F. Dessicant replacement is minimal (1-2 year cycle) depending on location and usage.

(c) Automatic drain or moisture traps (filters). Entrapped moisture in a air system is removed thru a drain or moisture trap (filter). This can be a simple drain cock or a self operating automatic trap. The simple drain cock requires a high degree of maintenance and can allow water to accumulate appreciably unless regular draining procedures are followed. However, an automatic drain will provide for the automatic removal of the moisture from the system as it condenses and will prevent further internal corrosion of components. This type of equipment should be used to protect major components of the pneumatic system.

(3) Equipment Installation. A feasibility study was made from ship's drawings (Reference 11) of the location plan for the catapult equipment in machinery room on deck 03 level to determine space available to install individual auxiliary

air dryer (Figure 6). The CV -63 aircraft carrier was used to establish the parameters of space and height available in a typical catapult machinery room. The CV -63 ship's drawings (Reference 11) were studied and the proposed air dryer was drawn in place in a typical plan view (Figure 6). In this proposed location the air dryer will provide auxiliary protection for each catapult pneumatic system. The catapult personnel will be responsible to maintain and service this equipment and thus assure a dry high pressure air source for their immediate operational use.

e. New Materials and Techniques for Corrosion Protection. A survey was conducted to find new protective coating materials or techniques which were applicable for corrosion protection of catapult pneumatic system components.

(1) Design Considerations for Coating Applications. In the design of equipment that are exposed to moisture it is good practice to eliminate pockets and crevices and provide adequate drainage. Surfaces in direct contact with moisture should be protected with inorganic coatings or finishes (phosphating, plating, etc.) where wear due to moving bearing loads are applied; in quiescent areas of moisture exposure the use of coatings (organic or inorganic) are recommended to protect against corrosion.

An analysis of the catapult pneumatic system components drawings (Reference 12) indicate that protective coatings or treatments can provide improved corrosion protection to these parts if properly applied to specific surfaces.

Organic or inorganic types of protective coatings or preservatives are applicable to internal surfaces of air flasks, quiescent internal surfaces of cylinder stroke end and caps.

Inorganic types of protective coatings or finishes are applicable to internal surfaces subjected to moving bearing loads of accumulators (retraction engine, bridle tensioner), stroke buffers (advance and retract), and cylinders (retraction engine, cable equalizer). Prior to use these coating and finish applications would initially require specific evaluation of each unit to determine the parameters of the bearing loads as applied to their surfaces.

f. Corrosion Protective Materials Available. The survey revealed the following materials (organic and inorganic) are currently available.

(1) Organic protective Materials. The following protective materials are available for NAEC evaluation.

(a) WD-40 (Rust Inhibitor)

Mfg'r: WD-40 Company
5390 Napa St.
San Diego, Calif. 92110

Evaluate as internal coating in air flask to protect surface from corrosion.

(b) QUELAQUA (Rust Inhibitor)
QUELRUST (Rust Inhibitor)

Mfg'r: QUELCOR, Inc.
P.O. Box 33
Media, Pa. 19063

Evaluate as internal coating in air flask to protect surface from corrosion.

(c) CARBOLINE 190HB (Coating)

Mfg'r: Carboline Company
328 Hanley Industrial Center
St. Louis, Missouri 63144

Evaluate as coating to protect components in non-fretting internal areas. A sample of this material was supplied to NAEC.

(d) 201 DEVRAN (Primer Coating)

Mfg'r: Devoe & Raynolds Co.
414 Wilson Ave.
Newark, N.J. 07105

Evaluate as coating to protect components in non-fretting internal areas. Sample material supplied to NAEC.

(e) PC-8151 (Exterior Coating)
PC-8152 (Primer Coating)

Mfg'r: U.S. Polymeric Co.
700 E. Dyer Rd.
Santa Anna, Calif. 92707

Evaluate as coating to protect components in non-fretting internal areas.

(2) Inorganic Protective Coatings and Finishes. The following inorganic coatings and finishes are available for further evaluation by NAEC.

(a) CARBO ZINC 11 (Coating)

Mfg'r: Carboline Company
328 Hanley Industrial Center
St. Louis, Missouri 63144

Evaluate as internal coating in air flask to protect surface from corrosion. A sample of this material was supplied to NAEC.

(b) CATHA-COAT 302 (Coating)

Mfg'r: Devoe & Raynolds Co.
414 Wilson Ave.
Newark, N.J. 07105

Evaluate as internal coating in air flask to protect surface from corrosion. A sample of this material was supplied to NAEC.

(c) DIMETCOTE (Coating)

Mfg'r: Ameron Co.
Corrosion Control Division
Brea, Calif. 92621

Evaluate as internal coating in air flask to protect surface from corrosion.

(d) PROB (Rust Inhibitor)

Mfg'r: Carboline Company
328 Hanley Industrial Center
St. Louis, Missouri 63144

Evaluate as internal coating in air flask to protect surface from corrosion. A sample of this material was supplied to NAEC.

(e) 105 SF (Coating-Finish)

Mfg'r: Metco Elec.
1101 Prospect Ave.
Westbury, N.Y. 1159

Evaluate as coating for accumulator and cylinder components where noncorrosion resistant base metal is used and protection is required in quiescent or medium range bearing load areas.

g. Literature Search on Corrosion Control. In addition to a survey of coating manufacturers for new materials and techniques to resist corrosion, a literature search of research activities concerned with various aspects of corrosion control was conducted.

Military agencies, such as; Army Materials and Mechanics Research Center, Watertown, Mass., Defense Supply Agency Cameron Station, Alexandria, Va. were contacted for reports or abstracts of research data on corrosion control.

NAEC library and trade associations, such as; National Association of Corrosion Engineers were consulted for information on current corrosion control techniques. In conjunction with the corrosion resistant design analysis reference was made to engineering handbooks, military handbook (MIL-HDBK-721 MR, Corrosion and Corrosion Protection of Metals) and abstracts from N. A. C. E. Corrosion Courses.

The literature search revealed that a vast amount of research effort is being spent to investigate corrosion protection of metals. This research effort is continually being explored by industry as well as the military and takes many forms of endeavor. The subjects vary from coating materials and applications, the effect metallurgical variations of metals, composite materials, techniques for electrodeposition of paint etc. Some of this research data has applications for catapult components but a detailed study of reports and articles is not within the scope of this current study.

As a result of contacting government agencies, trade associations, publications bibliographies, lists and abstracts of reports on corrosion protection of metals were obtained. To provide for a basis of further investigation some of these reports and abstracts have been included in Appendix H and J.

D. CONCLUSIONS

1. Preservation and Packaging of Components.

a. Design Procedure Evaluation. The preservation and packaging design procedures utilized at NAEC generally follow the acceptable military procedures established for military packaging. The basic military packaging control specifications (MIL-STD-794 and MIL-P-116) are the backbone of the design effort and require an experienced, competent technical specialist to properly interpret and utilize them effectively. This design procedure requires a coordinated effort of the specific departments (Chart I) responsible for establishing all the physical transportation and storage parameters for which an item should be protected. These parameters include (see MIL-STD-794) the critical nature of the item, value of the item, handling of the item, time in storage and the ultimate environment in which th item is to be stored and used.

The initial authority for the Preservation and Packaging determination of launcher and recovery equipment is the delegated responsibility of separate Commands, depending on the material category. The NAEC Industrial and Supply Departments are responsible for new or overhaul items and the Branch Aviation Supply Office is responsible for spare and provisioned items.

The basic preservation and packaging procedures for NAEC material is outlined in NAEC Instructions 4030-1D (Reference 3) as issued by NAEC Commanding Officer dated 16 Nov. 1970 and establishes policies for preservation, packaging and packing of material at NAEC.

The basic preservation and packaging procedures for the Branch Aviation Supply Office material is outlined in separate instructions issued by the Branch Aviation Supply Office, Officer-in-Charge which are instructions similar to those indicated in Reference 4. These instructions specify that Level "A" protection per MIL-STD-794 be used for their material.

These sources of supply of launcher and recovery systems components coordinate their efforts, where applicable, in delivering these items for fleet use. However, as a result of this study it was found that certain refinements of the overall preservation and packaging systems would further improve the delivery of usable components to the fleet.

(1) NAEC Engineering Department provides support for the preservation and packaging of components as indicated in Chart I. However, no one person or group within the launcher or recovery design groups has been assigned the responsibility for designing special packaging containers, and maintaining cognizance of the latest "state of the art" improvements in the preservation and packaging of their components.

(2) NAEC Industrial Department is responsible for preservation, packaging and packing of components as shown in Chart I. To designate the methods and material to accomplish this they utilize those specified in MIL-P-116. They do not support within the department a "state of the art" improvement program on preservation and packaging since they have not been delegated to maintain such a program. All marking of their packaged items is in accordance with MIL-STD-129 and they donot determine and mark items with regard to end use as "critical" and requiresspecial handling.

(3) As a result of field surveys with personnel who received packaged components from supply depots and ship's stores it was found that inadequate marking (numbers or nomenclature omitted, illegible etc.) was a problem. This is attributed to marking deficiencies occurring at the source of manufacture or supply where marking specifications are not followed completely.

(4) Reports are issued by field personnel indicating defective components detected in the field (depot or ship board). The two principle report forms; NAEC 2104, Arresting Gear Field Technical Report and NAEC 13810/5 Steam Catapult Field Technical Report do not contain Line Items designating Preservation and Packaging Problems (Appendix E). Consequently, NAEC Departments directly concerned with packaging and preservation do not receive this information directly and thus impedes immediate responsive action. This is particularly the case with BRASO who does not receive these reports.

(5) A complete investigation of a series of field reports (Chart V) on defective components found to be rusting in the field revealed they were initially properly packaged if BRASO requirements were followed. Consequently it was evident that improper handling or unauthorized opening of these packages was responsible for the components rusting.

(6) The materials survey for new strippable coatings (similar to MIL-P-149) resulted in obtaining data (Chart II) on available current materials. These materials have been approved for protecting parts from corrosion. Therefore the application and evaluation of these materials for launcher and recovery system components could provide an improvement of their current methods of protection.

(7) The survey of defective component reports indicated improper handling of package components to be a source of the corrosion problems. However, the study was unable to determine the existenceof any present method of indoctrination or training of fleet personnel in the importance of handling these packaged components to prevent damage or unauthorized opening prior to use.

2. Corrosion Control of Catapult Pneumatic System.

a. Moisture Prevention in the Pneumatic System. A study of the catapult pneumatic system in conjunction with the ship's (CV 63) high pressure (3000 PSI) air supply system was made and it was found that an extensive distribution network of piping is installed prior to the delivery of air to the source for the catapult operation which could permit the condensation of moisture in the compressed air. A survey of field personnel who work directly with the catapult operation indicated they experienced the delivery of moisture laden compressed air at the catapult air flasks.

A further survey by NAEC Field Technicians of aircraft carriers (CV 62, CV 42; CV 63) in port at Norfolk, Va., Mayport, Fla. and San Francisco, Calif. revealed an inconsistency in the maintenance procedures utilized in the operation of the ship's high pressure air (3000 PSI) drying equipment (compressed air dehydrators; Reference 10). Due to these operational variations between ships' equipment, an analysis could not determine whether the

high pressure air dryers installed aboard ship were efficient enough to control the moisture content of the high pressure compressed air, or if the lack of adequate maintenance procedures contributed to the inefficiency of operation of the dryers in controlling the quality of compressed air delivered to the catapult pneumatic system. Consequently, a more detailed study of the efficiency of the ship's high pressure air system must be made. This will require operating a ship's high pressure air system with all the appropriate maintenance procedures (manual, MRC, etc. verified) in effect and then conduct an analysis of the quality of air being delivered to the catapults air flask (Figure 4). If the air is then found to contain moisture it will require the installation of a separate dryer in the catapult pneumatic system (Figure 6).

Acceptable sites were located aboard ship (Figure 6) where the installation of an auxiliary dryer can be made. This typical installation was determined from a study of ship's drawings (Reference 11).

b. A materials search for new corrosion resistant coatings resulted in obtaining data and sample materials for potential application on catapult pneumatic components. A feasibility study was made of catapult pneumatic components to determine where appropriate applications of these materials could possibly be used.

c. The literature search revealed that a myriad of information is available on the research activities directed towards corrosion control of metals. Many sources and reports have been documented (Appendix J) as a basis for future reference since a detailed study of this data was not included in the scope of this report.

E. FUTURE ACTIONS:

1. Preservation and Packaging of Components.

a. Evaluation of NAEC Preservation and Packaging Procedures. To improve the flow of information and provide for the latest "state of the art" capabilities the following refinements should be incorporated in the NAEC Preservation and Packaging Procedures.

(1) The Launcher and Recovery Systems Design Group should contain personnel who have technical cognizance of the preservation and packaging systems as applicable to their components. In this capacity these individuals would be responsible to:

(a) Coordinate all technical data related to preservation and packaging of their materials with Materials and Process Office, Supply Department, Quality Assurance Department, etc.

(b) Review pertinent component drawings and determine which components require critical considerations in methods of preservation and packaging.

(c) In house review of all reports (Field, Quality Assurance etc.) related to preservation and packaging. Maintain personal contact with field personnel to evaluate package handling, stowage or other logistic problems developed aboard ship.

(d) Be responsible for all special container designs.

(e) Maintain continuous contact with other Government agencies (i.e., packaging labs) and manufacturers of packaging and preservation materials to develop the latest "state of the art" knowledge of preservation and packaging systems, techniques, and processes.

(2) The Industrial Department should participate in "state of the art" improvement program for preservation and packaging of their components; they also should mark all packaging of critical items accordingly, and in the same manner as BRASO so that a standard preservation and packaging system will evolve.

(3) Marking specification MIL-STD-129 provides for optional special handling marking (Paragraph 5.4.28; MIL-STD-129). NAEC procedures should provide for designating all components which are considered critical to the operation of the launcher and recovery systems and then specifying appropriate notification marking on all these packaged components. This special marking should read, "Critical, if opened for inspection repackage to Level "A" per MIL-STD-794" A more detailed set of packaging instructions (developed by a packaging specialist) should be supplied to the manufacturing source inspection and thus reduce the need for interpretation of requirement specification (such as MIL-STD-794). This could be accomplished by the use of a modified form similar to Chart V containing a detailed check off list of preservation and packaging methods.

(4) The field report forms issued by NAEC Field Technicians for problems detected in the field should contain Line Items related to preservation and packaging. These forms (Appendix E-1; E-2) should incorporate the following: Form, NAEC2104 (Rev. 8/69) "Arresting Gear Field Technical Report" add line 15. Preservation and Packaging. ;Form, NAEC13810/5 (Rev. 3/73) "Steam Catapult Field Technical Report" add to line 14. Corrosion Control/ Packaging Problems.

(5) To lower the frequency of these defective component problems, better instructions should be given to update handling personnel (field and fleet) concerning the importance of maintaining complete packaging and preservation of the system until used. More utilization of notice marking (Item 3 above) should be effected.

(6) New Materials (Chart II). Greater use should be made transparent strippable coatings or wrap materials which would permit visual inspection of critical parts without exposing them to direct handling or corrosive environments. Some new materials (similar to MIL-P-149) available for evaluation are as follows;

(a) N-4 (55) (Coating, hot dip, strippable)

Mfg'r: Thermo Cote, Inc.
798 21st Ave.
Patterson, N.J. 07513

Evaluate as a strippable coating (similar to MIL-P-149) for preservation of parts to be stored in a marine environment. Sample material supplied to NAEC.

(b) THERMO-COTE I (Coating, hot dip, strippable)
THERMO-COTE 149 (Coating, hot dip, strippable)
THERMO-COTE 149A-11 (Coating, hot dip, strippable)

Mfg'r: Thermo Cote Inc.
798 21st Ave.
Patterson, N.J. 07513

Evaluate as a strippable coating for preserving catapult components. These materials meet MIL-P-149 requirements.

(c) PROTEXO-COTE BL (Coating, brush, spray, cold dip, strippable)
PROTEXO-COTE V-12 (Coating, brush, spray, cold dip, strippable)

Mfg'r: Thermo Cote Inc.
798 21st Ave.
Patterson, N.J. 07513

Evaluate as strippable coatings for preservation of large catapult components which are not adaptable to hot dip techniques.

(d) SC-1074B-1 (Coating, base, spray, strippable)
SC-1090 (Coating, top, spray, strippable)

Mfg'r: Spraylat Corp.
One Park Ave.
New York, N.Y. 10016

Evaluate as strippable coatings (meets MIL-C-6799) for preservation of large catapult components which are not adaptable to hot dip techniques. Sample material supplied to NAEC.

(e) SC-270 (Coating, spray, strippable)

Mfg'r: Spraylat Corp.
One Park Ave.
New York, N.Y. 10016

Evaluate as strippable coating for preservation of large catapult components which are not adaptable to hot dip techniques. Sample material supplied to NAEC.

(g) PC-8220 (Coating, spray, strippable)

Mfg'r: U.S. Polymeric Co.
700 E. Dyer Rd.
Santa Anna, Calif. 92707

Evaluate as strippable coating for preservation of large catapult components which are not adaptable to hot dip techniques. Sample coupons supplied to NAEC.

(h) 1075 (Coating, spray, strippable)

Mfg'r: QUELCOR, Inc.
P.O. Box 33
Media, Pa. 19063

Evaluate as strippable coating for preservation of large catapult components which are not adaptable to hot dip techniques.

2. Corrosion Control of Catapult Pneumatic System.

a. Moisture Prevention in the Pneumatic System (Figure 3). To determine if the source of moisture accumulation in the catapult pneumatic system is due to the inefficiency of the ship's high pressure air dryer a test must be performed on an approved aircraft carrier's high pressure air system. The system should have the high pressure compressor (Reference 9) and air dryer (Reference 10) equipment checked in accordance with the prescribed maintenance procedures and then operated. An analysis of the high pressure air then being delivered to the catapult air flask should be made for moisture content. If the quality of air is not dry as required then an auxiliary air dryer (Figures 8 and 9) should be installed in the catapult pneumatic system (Figure 3) directly to the air flask adjacent to the retraction engine installation. Space is available aboard ship (Figure 6) to provide for the installation of this equipment.

If tests prove the quality of high pressure air to be as dry as required for the operation of the catapult pneumatic system then the maintenance and operation procedures utilized for the test of the high pressure air system should be incorporated aboard all aircraft carrier's high pressure (3000 PSI) compressed air systems operations.

Commercially available compressed air dryers are available to install in the catapult pneumatic system to provide the required dry air. These compressed air dryers operate on different techniques to effectively remove moisture from compressed air. Either of two different types are recommended which would meet the air flow and pressure requirements and at the same time require minimum maintenance when installed aboard ship. These recommended compressed air dryers are:

(1) *E-10 Stainless Steel Dryer (Figure 8)

Refrigeration type rated at 3000 PSI, 1-5 SCFM

Cost $620.00	8 weeks delivery
Mfg. by:	Hankinson Corp. Canonsburg, Pa. 15317

(2) *HPS-60 Heaterless Dryer (Figure 9)

Absorption Type rated at 3000 -3500 PSI, 30 SCFM

Cost $3,140.00	12-14 weeks delivery
Mfg. by:	Kahn and Co.

* See Appendix L for details.

b. The new materials cited in Chart II are available to be evaluated by NAEC for application as corrosion preventative coatings for catapult components (air flask, accumulator, etc.).

c. The reports, abstracts, indicies, (Appendix J) documented as a result of the literature search are a source for future investigation on corrosion control by NAEC.

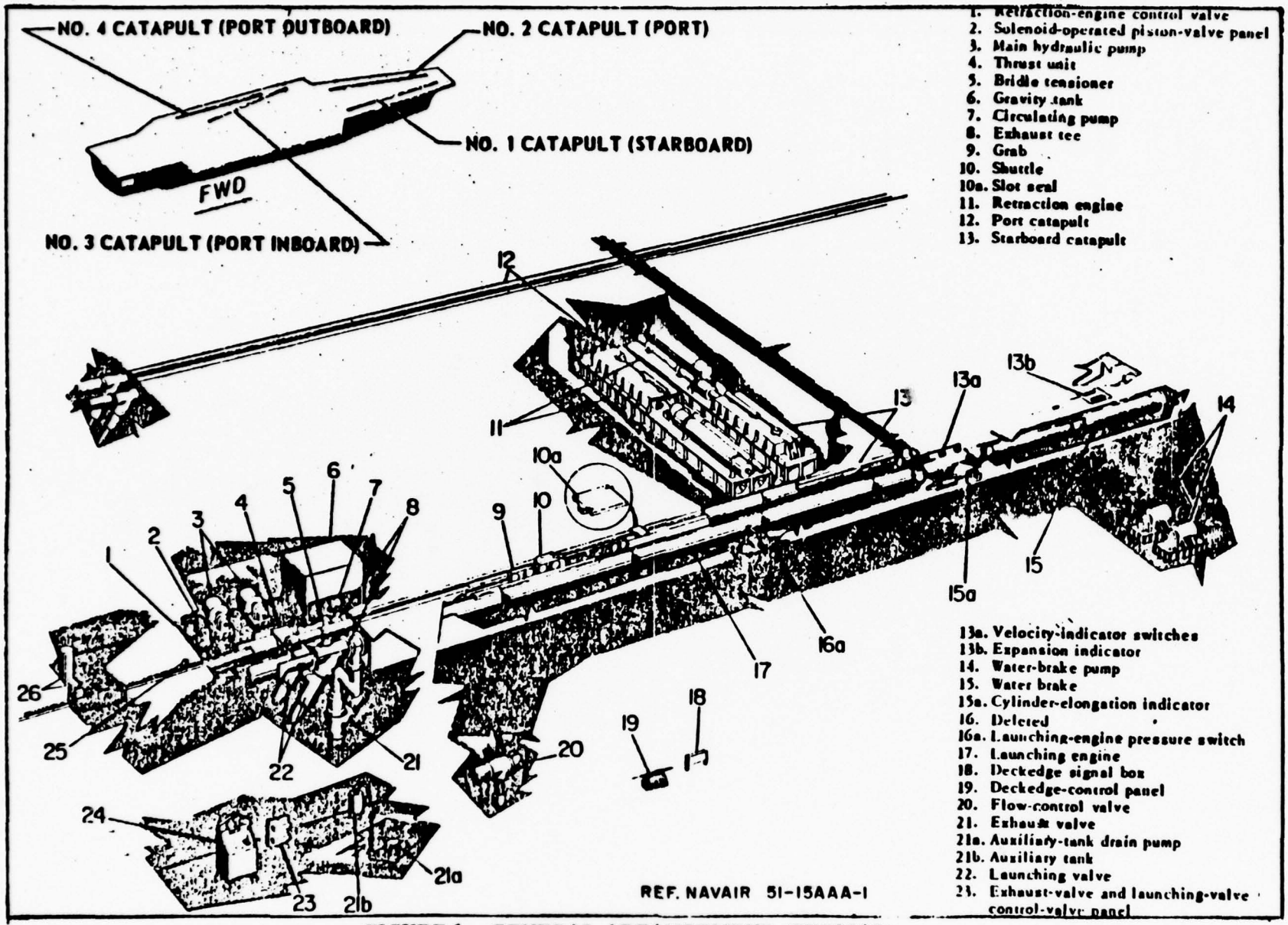


FIGURE 1. GENERAL ARRANGEMENT (TYPICAL)

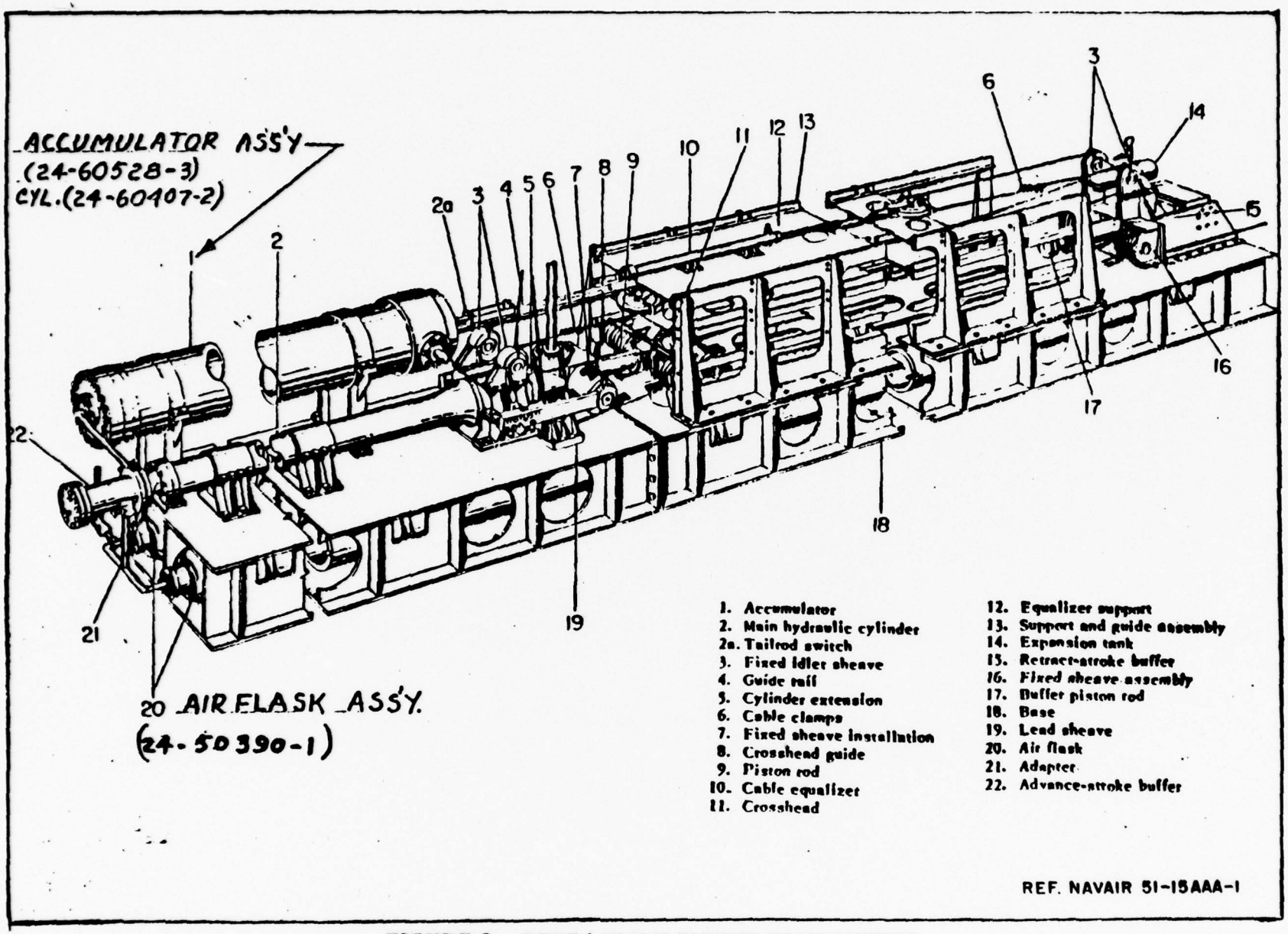


FIGURE 2. RETRACTION ENGINE COMPONENTS

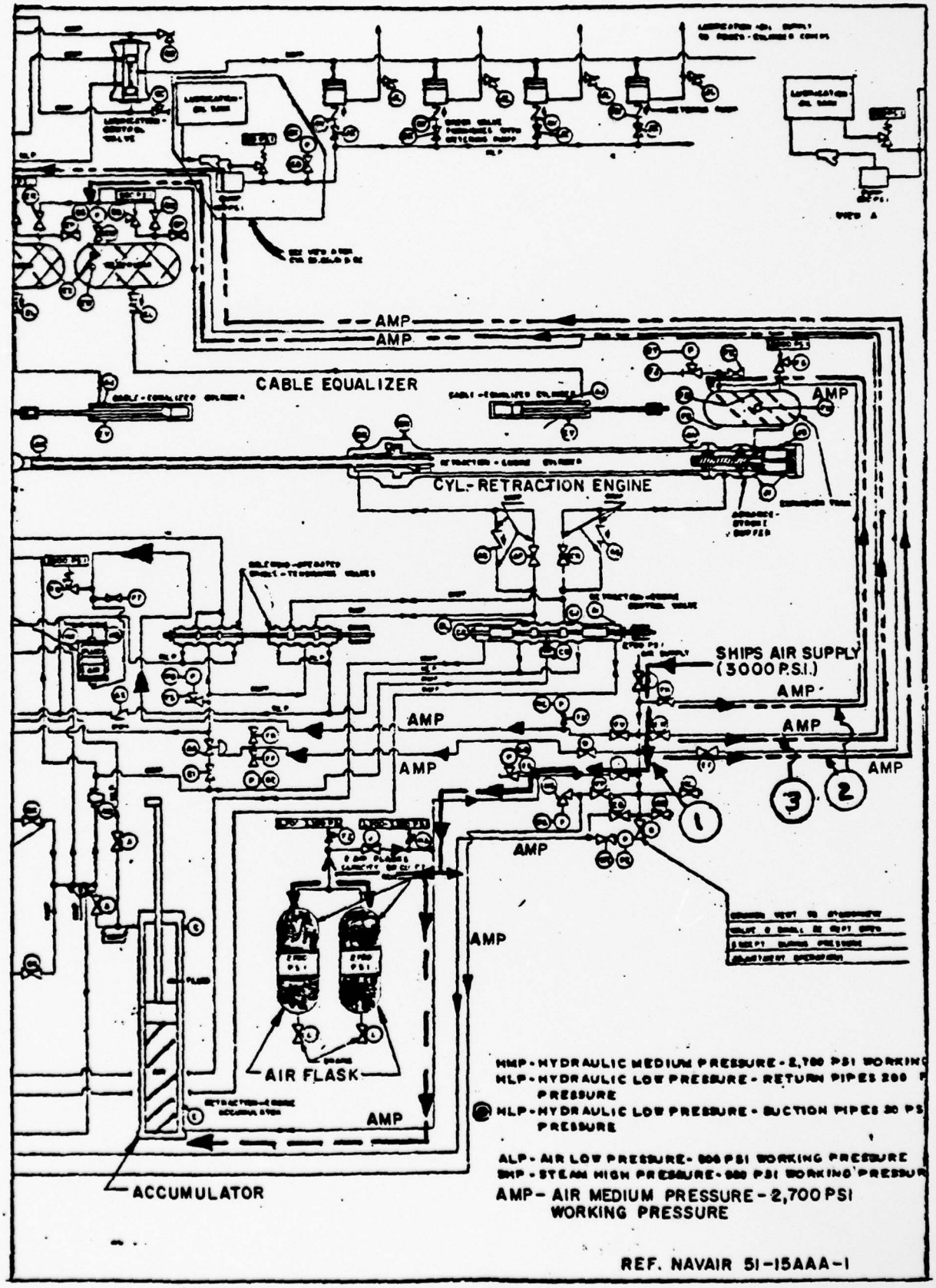


FIGURE 3. SCHEMATIC OF PNEUMATIC SYSTEM

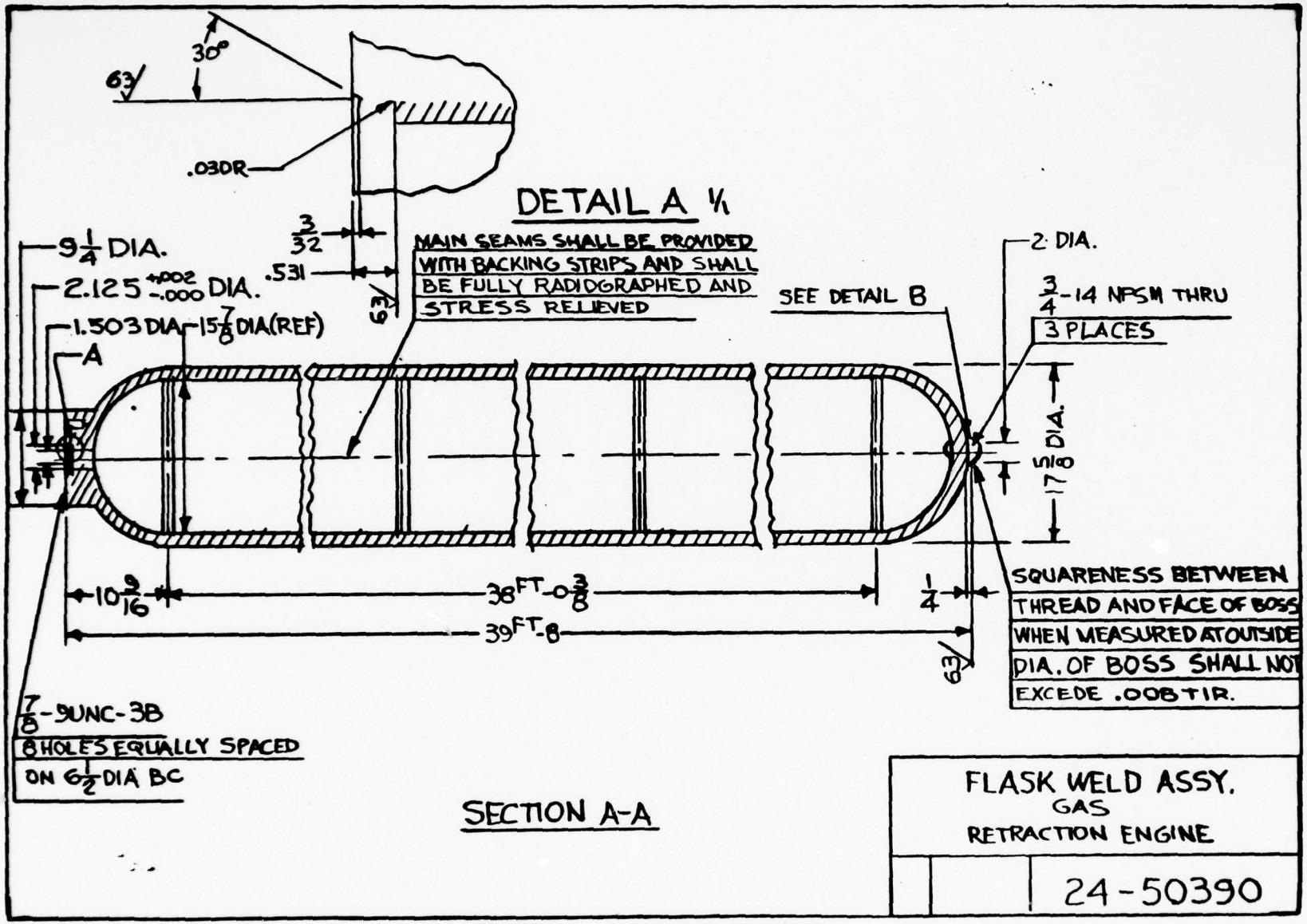
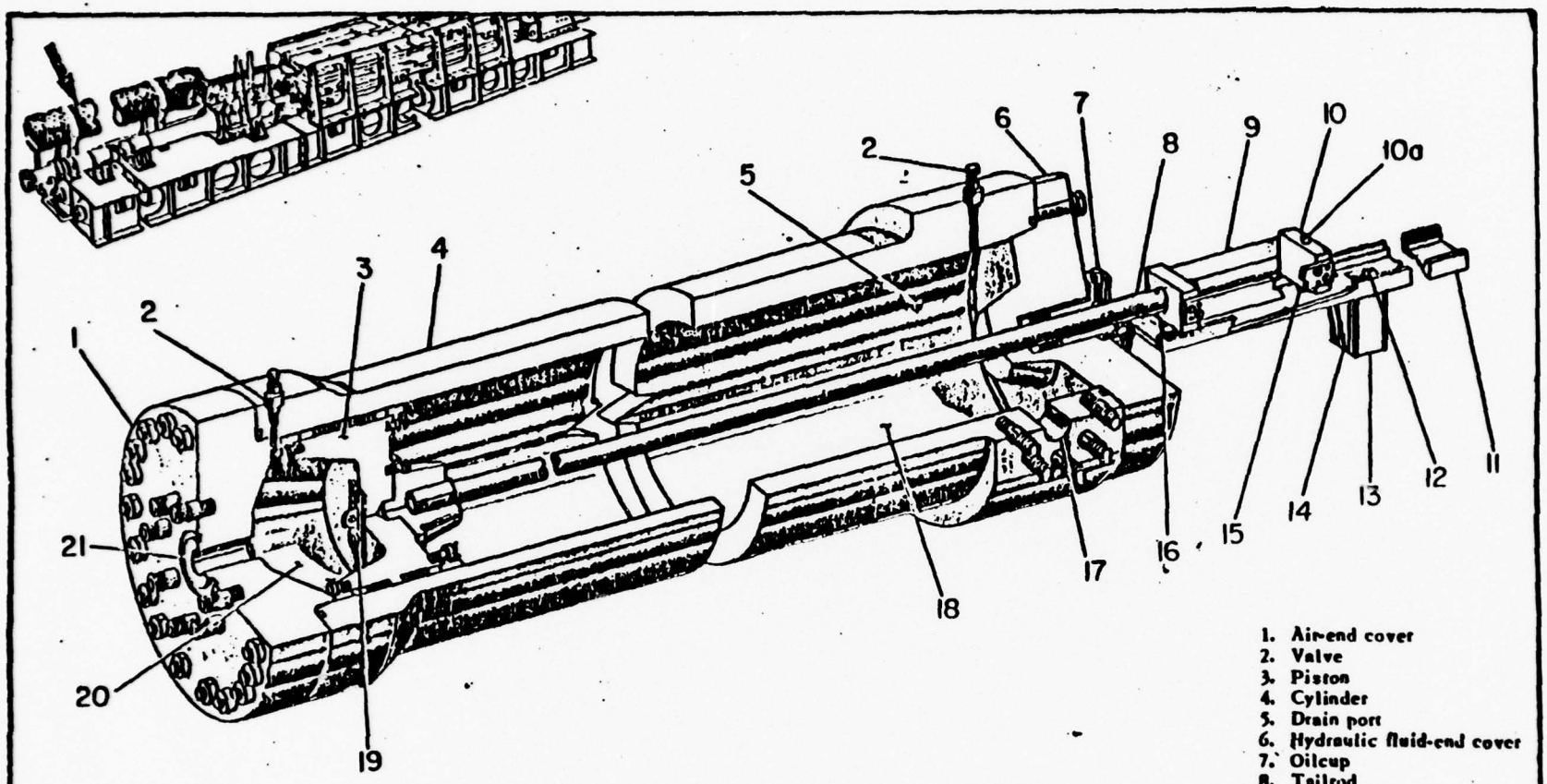


FIGURE 4. AIR FLASK SKETCH



REF. NAVAIR 51-15AAA-1

1. Air-end cover
2. Valve
3. Piston
4. Cylinder
5. Drain port
6. Hydraulic fluid-end cover
7. Oilcup
8. Tailrod
9. Strap
10. Tailrod guide
10a. Actuating pin (ref)
11. Guide rail
12. Lever
13. Tailrod switch
14. Mounting bracket
15. Cam
16. Cam
17. Hydraulic port (Port Y)
18. Hydraulic fluid chamber
19. Tow bracket
20. Air chamber
21. Air port (Port X)

FIGURE 5 ACCUMULATOR SKETCH

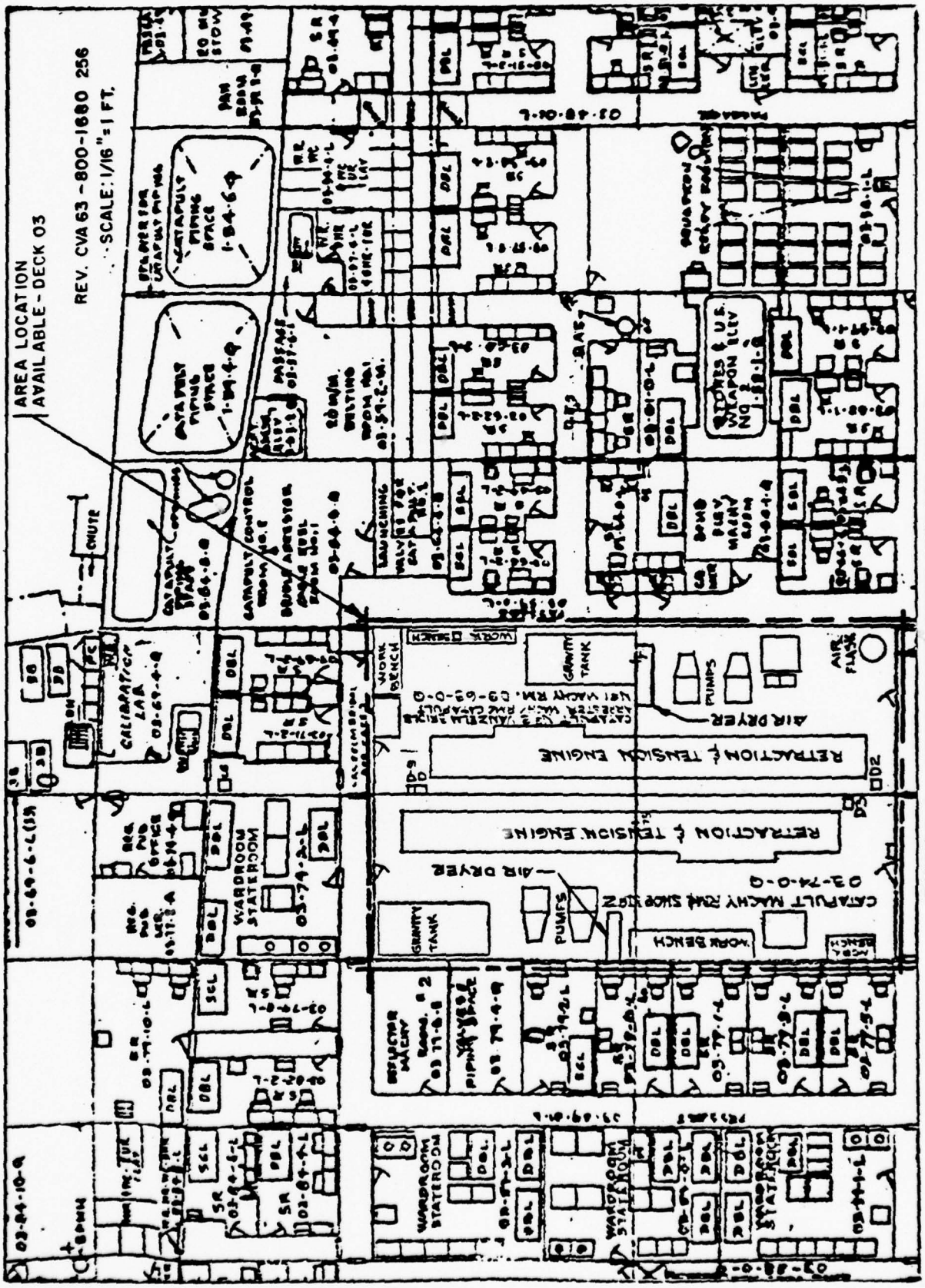


FIGURE 6. PROPOSED DRYER INSTALLATION

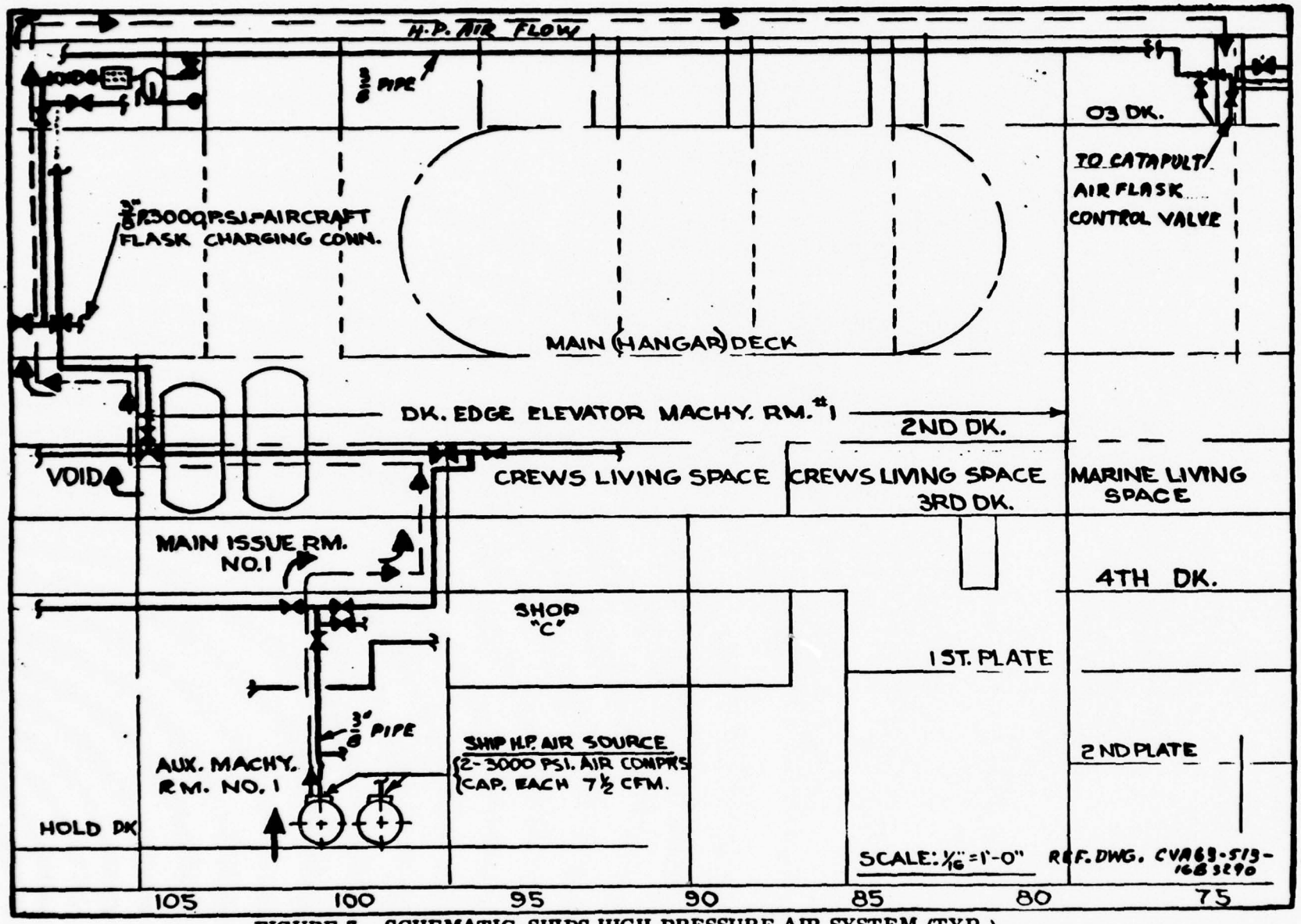


FIGURE 7. SCHEMATIC-SHIPS HIGH PRESSURE AIR SYSTEM (TYP.)

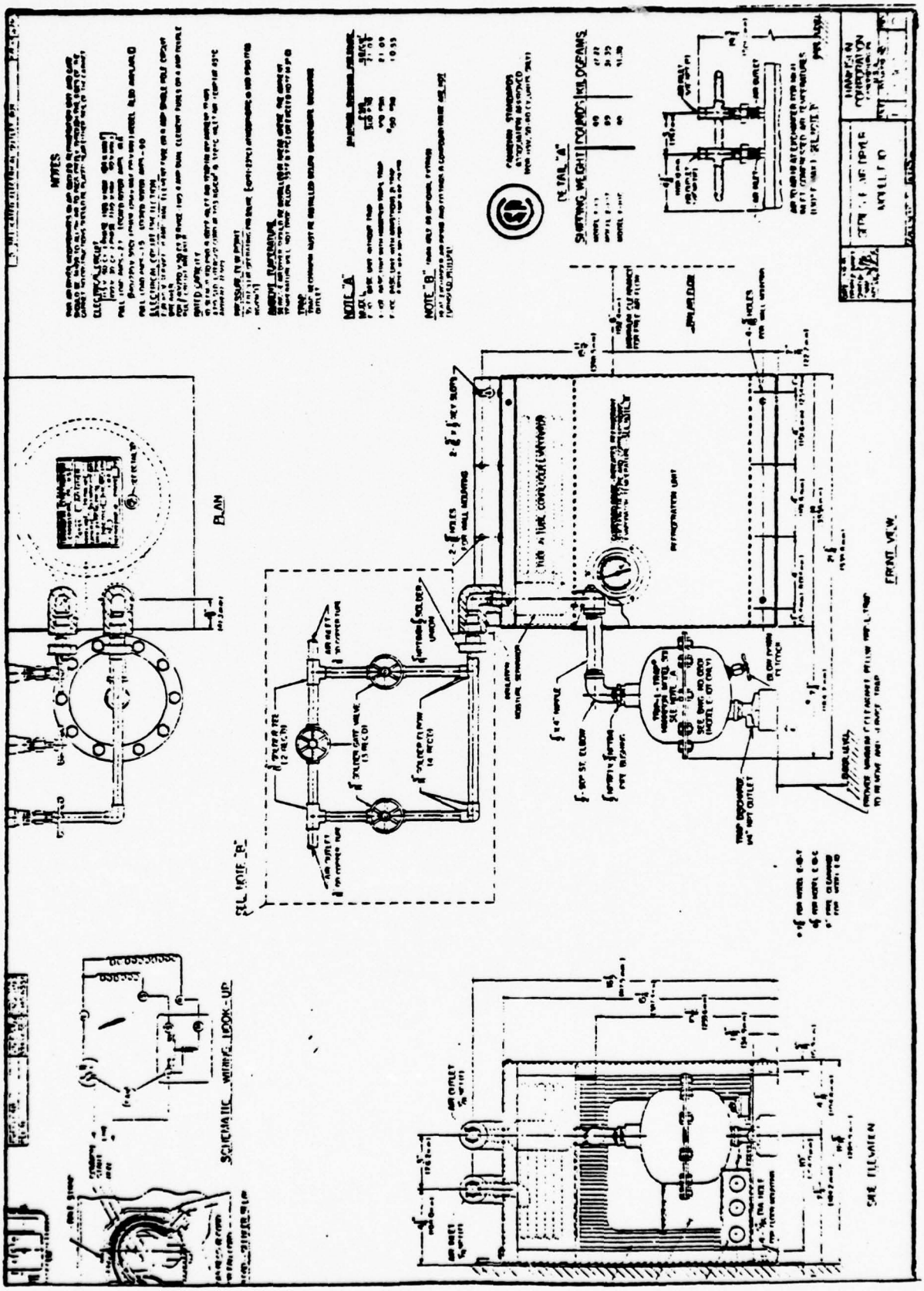


FIGURE 8. DRYER (REFRIGERANT TYPE) SKETCH

HPS SERIES DRYERS

Pneumatic Schematic & Installation Drawings

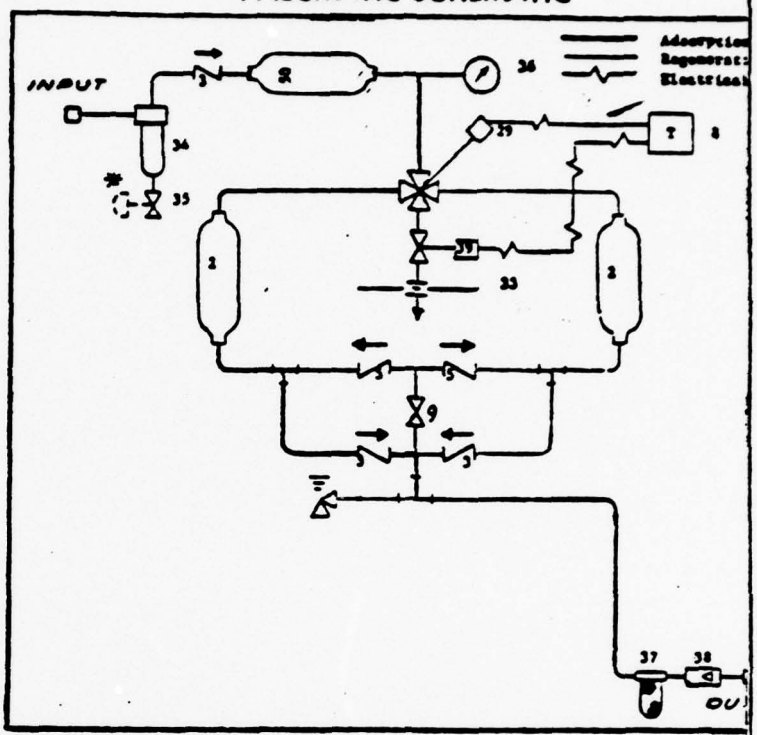
KAHN & COMPANY INC.

SYMBOLS (*optional equipment)

1. SELECTOR VALVE
2. ADSORPTION TOWER
3. PROCESS CHECK VALVE
4. RELIEF VALVE
5. PURGE CHECK VALVE
8. CAM TIMER
9. PURGE VALVE
10. ELECTRICAL BOX
29. ACTUATOR
30. SWITCH
30A. FUSE
31. PILOT LIGHT
33. BLOWDOWN LIMITER
34. ENTRAINMENT SEPARATOR
35. DRAIN VALVE (Note 1)
36. PRESSURE GAUGE
*37. AFTERFILTER
38. PRIORITY VALVE
39. REPRESSURIZATION VALVE
*50. OIL VAPOR FILTER

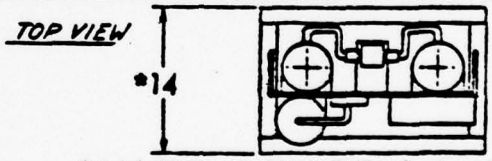
Note 1: Standard unit with manual valve. Remotely controlled drain valve is optional.

PNEUMATIC SCHEMATIC



INSTALLATION DRAWINGS

MODEL NO.	DIMENSIONS				
	A	B	OUTLET	INLET	DRAIN
30	33	21	1/4" NPT	1/4" NPT	1/4"
60	44	24	3/8" NPT	3/8" NPT	NPT



*Add 5" for NEMA 7 Explosion Proo

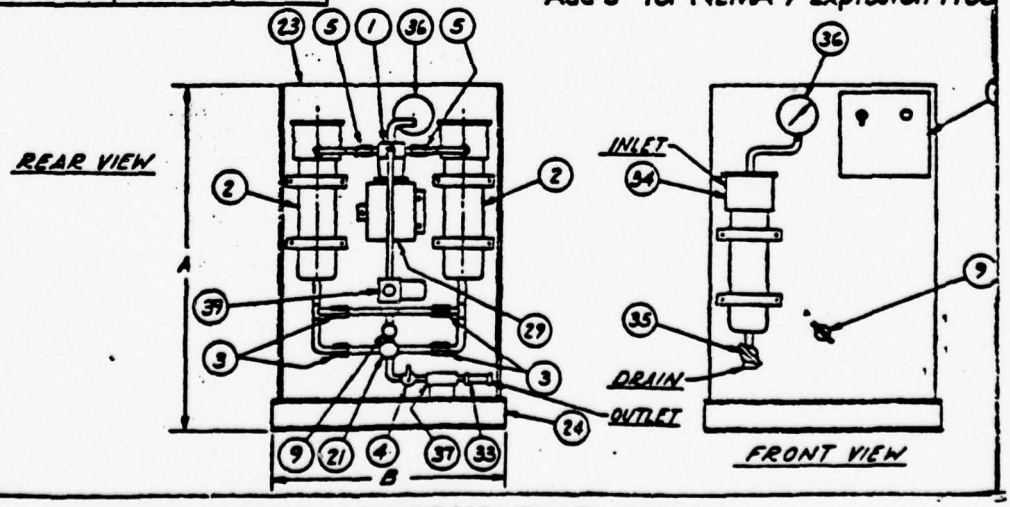


FIGURE 9. DRYER (ABSORBANT TYPE) SKETCH

VI CHART INDEX

CHART I

FLOW OF NAEC PACKAGING DESIGN DATA

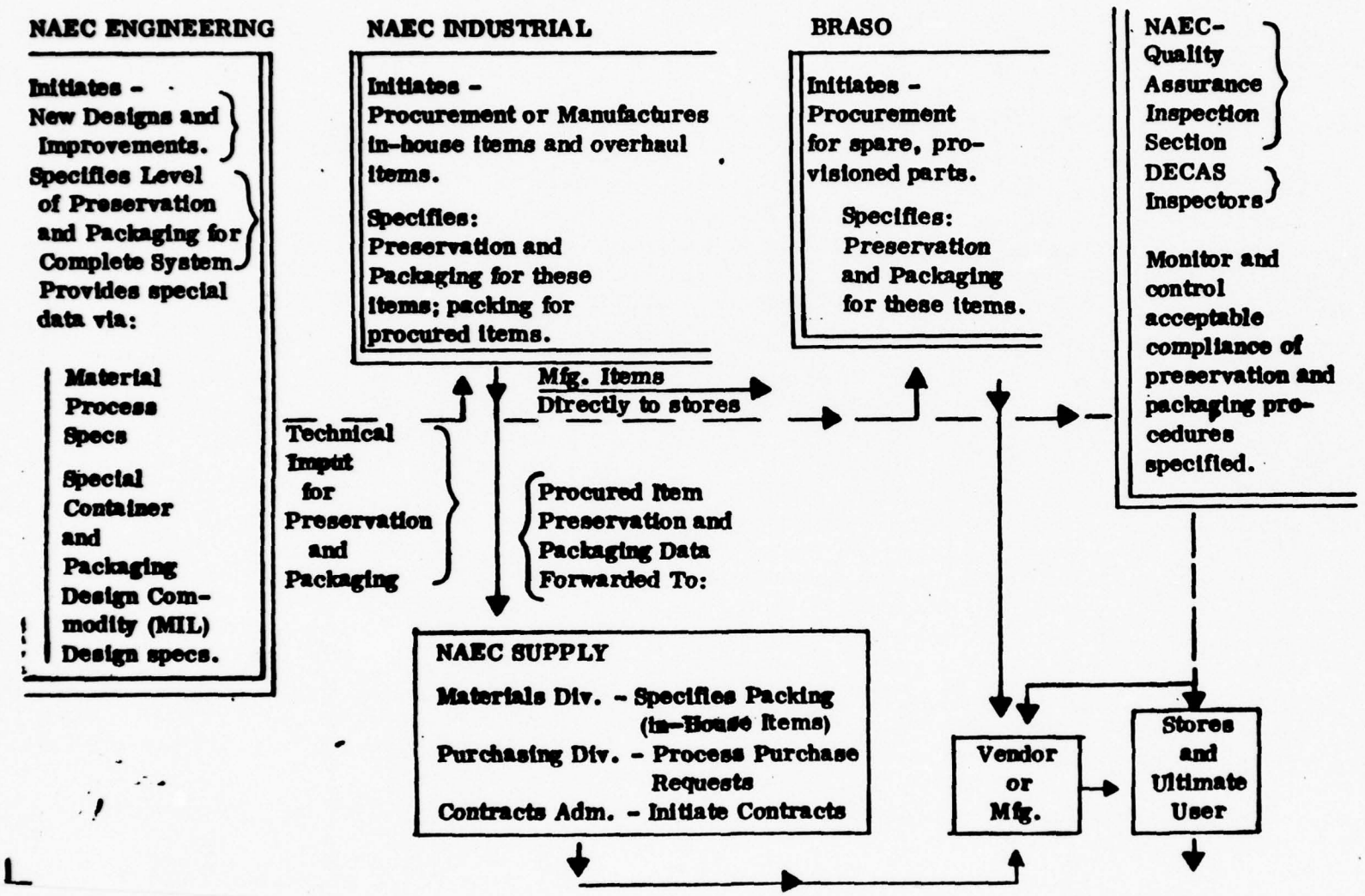


CHART II

NEW MATERIALS FOR NAEC EVALUATION.

PRESERVATION AND PACKAGING

MATERIAL NO.	TYPE	APPLICATION	MFG'R
N-4(55)	Strippable	Preservation	Thermo Cote Co.
*Thermo-Cote I	Strippable	Preservation	Thermo Cote Co.
*Thermo-Cote 149	Strippable	Preservation	Thermo Cote Co.
*Thermo-Cote 149A-11	Strippable	Preservation	Thermo Cote Co.
Protexo-Cote BL	Strippable	Preservation	Thermo Cote Co.
Protexo-Cote Y-12	Strippable	Preservation	Thermo Cote Co.
SC-1074B-1	Strippable	Preservation	Spraylat Corp.
SC-1090	Strippable	Preservation	Spraylat Corp.
SC-270	Strippable	Preservation	Spaylat Corp.
PC-8220	Strippable	Preservation	U.S. Polymeric Co.
PC-8230	Strippable	Preservation	U.S. Polymeric Co.
1075	Strippable	Preservation	Quelcor Inc.

* Hot dip mat'l - all others above can be sprayed.

CORROSION CONTROL

MATERIAL NO.	TYPE	APPLICATION	MFG'R
Prob	Corrosion Inhibitor	Internal Surfaces	Carboline Co.
Quelaqua	Corrosion Inhibitor	Internal Surfaces	Quelcor, Inc.
Quelrust	Corrosion Inhibitor	Internal Surfaces	Quelcor, Inc.
WD-40	Corrosion Inhibitor	Internal Surfaces	WD-40 Company
190 HB	Coating	Non-Fretting Surfaces	Carboline Co.
201 Devran	Coating	Non-Fretting Surfaces	Devoe and Raynolds Co.

CHART II (CONT'D)

NEW MATERIALS FOR NAEC EVALUATION

CORROSION CONTROL

MATERIAL NO.	TYPE	APPLICATION	MFG'R.
PC-8151	Coating	Non-Fretting Surfaces	U. S. Polymeric Co.
PC8152	Coating	Non-Fretting Surfaces	U.S. Polymeric Co.
#81	Coating	Non-Fretting Surfaces	Ameron Co.
#82	Coating	Non-Fretting Surfaces	Ameron Co.
Carbo Zinc 11	Coating	Mild-Fretting Surfaces	Carboline Co.
Catha-Coat 302	Coating	Mild-Fretting Surfaces	Devoe and Raynolds Co.
Dimetcote	Coating	Mild-Fretting Surfaces	Ameron Co.
105SF	Coating	Hi-Fretting Surfaces	Metco Co.

CHART III

RELATIONSHIP OF PACKAGING CONTROL MIL-SPECS.

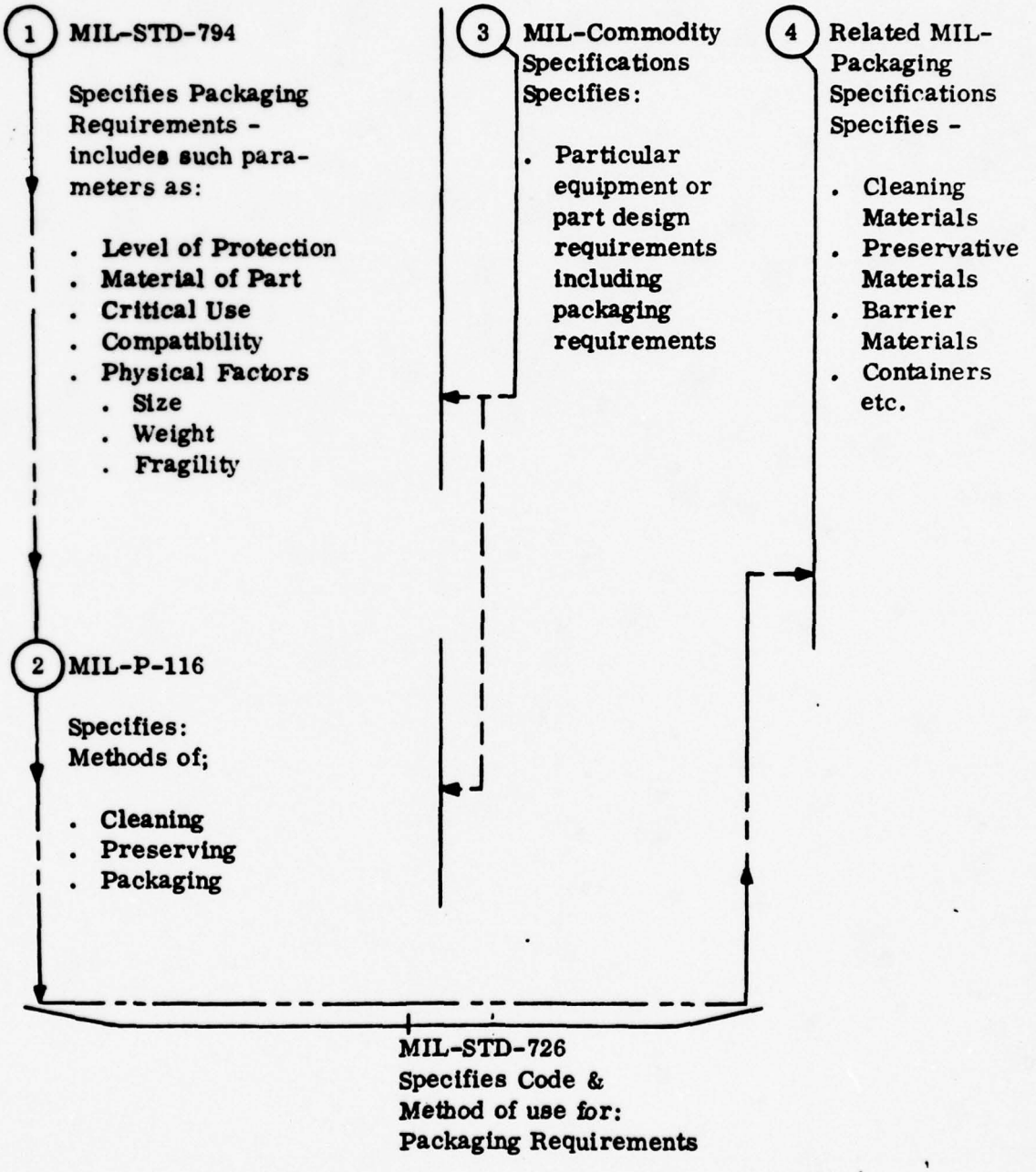


CHART IV

EVALUATION OF FIELD REPORTS (APP. F)

Field Tech Report or Req't for Salvage Action No. and Date	NAEC Part Number or MIL-SPEC	Federal* Stock Number	Part* Name	P. and P. Level*	M.P.R. Applicable	Method of Preser-vation*	Type of Preser-ative*	ACTION	
								Effected	Recommended
#148-72 6-19-72	MIL-T-23426	1R1720-866-7019 etc.	Tension Bars	A		III	P1 or P1g		Proposed Amend. to Procurement Specification
#157-72 6-26-72	614148-1		Barricade	A	1290	II		New Method to Pres.; Pkg.	
72-6055 4-11-72	501549-7	5RM-1710-626-1326	Level Assy	A		IA-14	GR-2	Pres. & Pkg. **	Adequate
72-6028 3-7-72	A414240-1	4730 901-6287	Nut, Union					Not BRASO or NAEC cog't	Defense Industrial Supply Center should be notified
72-6010 2-9-72	C87780-47	5RM3110-278-6952	Race, Inner	A	1262	IA and IB	GR-2	Pres. & Pkg.	Adequate

* Data from BRASO History Cards (BRASO Form 17).

CHART IV (CONT'D)

EVALUATION OF FIELD REPORTS (APP. F)

Field Tech Report or Req't for Salvage Action No. and Date	NAEC Part Number or MIL-SPEC	Federal Stock Number	Part Name	P. and P. Level	M.P.R. Applicable	Method of Preservation	Type of Preservative	ACTION	
								Effected	Recommended
71-6130 or -6150 10-15-71	509185-3	5RM1710-911-1702	Sheave Sub-Assembly	A	1262		GR-2	Pres. & Pkg.	Adequate
71-6125 7-21-71	53-40112-2	RM1710-315-9862 KCAC	Spacer, Inner	A		IA-8	GR-2	Pres. & Pkg.	Adequate
70-6082 5-18-70	29-40707 775	5RM1720-592-1989	Cable Assy.	A			GR-1	New Method to Pres. & Pkg.	
70-6053 5-6-70	A414240-1	4730-901-6287	Nut, Union					Not BRASO or NAEC Cog't	Same as:' 72-6028
69-6176 12-10-69	53-40112-2	1710-315 9562	Spacer, Inner	A		IA-8	GR-2		Same as: 71-6125

CHART IV (CONT'D)

EVALUATION OF FIELD REPORTS (APP. F)

Field Tech Report or Req't for Salvage Action No. and Date	NAEC Part Number or MIL-SPEC	Federal Stock Number	Part Name	P. and P. Level	M.P.R. Applicable	Method of Preser-vation	Type of Preser-ative	ACTION	
								Effected	Recom-mended
69-6146 9-23-69	408402-1	R1710-896-7199 KCAG	Sleeve	A		IA	GR-2		Use MIL-B-131 in lieu of MIL-B-121
68-6046 4-30-68	A-92791-27-1750-0	RM4010-993-1782-KCAG	Rope, Wire	A			GR-1	New Method to Pres. & Pkg.	
68-6026 2-19-68	A-92791-13-600	4R4010-663-8046	Rope, Wire	A			GR-1	New Method to Pres. & Pkg.	
66-6050 4-14-66	408084-2	1720-225-0590	Track Section	A		IA-15	GR-2	Pres. & Pkg.	Adequate
66-6037 2-28-66	400790-1	RM1710-315-9631 KCAG	Socket, Eye End	A			GR-2		Use MIL-B-131 in lieu of MIL-B-121

CHART IV (CONT'D)

EVALUATION OF FIELD REPORTS (APP. F)

Field Tech Report or Req't for Salvage Action No. and Date	NAEC Part Number or MIL-SPEC	Federal Stock Number	Part Name	P. and P. Level	M.P.R. Applicable	Method of Preser-vation	Type of Preser-ative	ACTION	
								Effected	Recommended
66-6021 2-16-66	71-40212-2	5RM1710-316-0033	Spacer, Inner	A		IA-8	GR-2	Pres. & Pkg.	Adequate
66-6014 1-27-66	317434-1	9Z5306-805-3394	Clevis Pin			IC-2	GR-2	Not BRASO or NAEC Cog't.	Same as: 72-6028
No number, Photo only Feb '66	504130-1	5RM1710-717-6815	Rod, Piston	A		IA	GR-2	Only Photo Available Showing Rust	
No Number, Photo only Feb '66	504047-1	4RM1710-771-1284	Cap Ass'y			I	GR-2		Same as: 65-6093

CHART IV (CONT'D)

EVALUATION OF FIELD REPORTS (APP. F)

Field Tech Report or Req't for Salvage Action No. and Date	NAEC Part Number or MIL-SPEC	Federal Stock Number	Part Name	P. and P. Level	M.P.R. Applicable	Method of Preser-vation	Type of Preser-ative	ACTION	
								Effected	Recommended
65-6093 12-1-65	504047-1	4RM1710-771-1284	Cap Ass'y			I	GR-2		Use MIL-B-121 in lieu of MIL-B-131
No Report	504821-1	5RM1720-830-3229	Strap Ass'y	A	1283		MIL-G-23827	Pres. & Pkg.	Adequate
No Report	504821-3	5RM1720-961-6481	Strap Ass'y	A	1283		MIL-G-23827	Pres. & Pkg.	Adequate
No Report	509979-1	5RM1720-917-4377	Valve	A per STD-749					Detail Req'ts for level "A"
No Report	613101-7	4RH1720-225-2657	Piston Ass'y	A			GR-2		Use MIL-B-131 in lieu of MIL-B-121
No Report	613102-13	4RH1720-225-2658	Piston Assy	A			GR-2		Use MIL-B-131 in lieu of MIL-B-121

CHART IV (CONT'D)

EVALUATION OF FIELD REPORTS (APP. F)

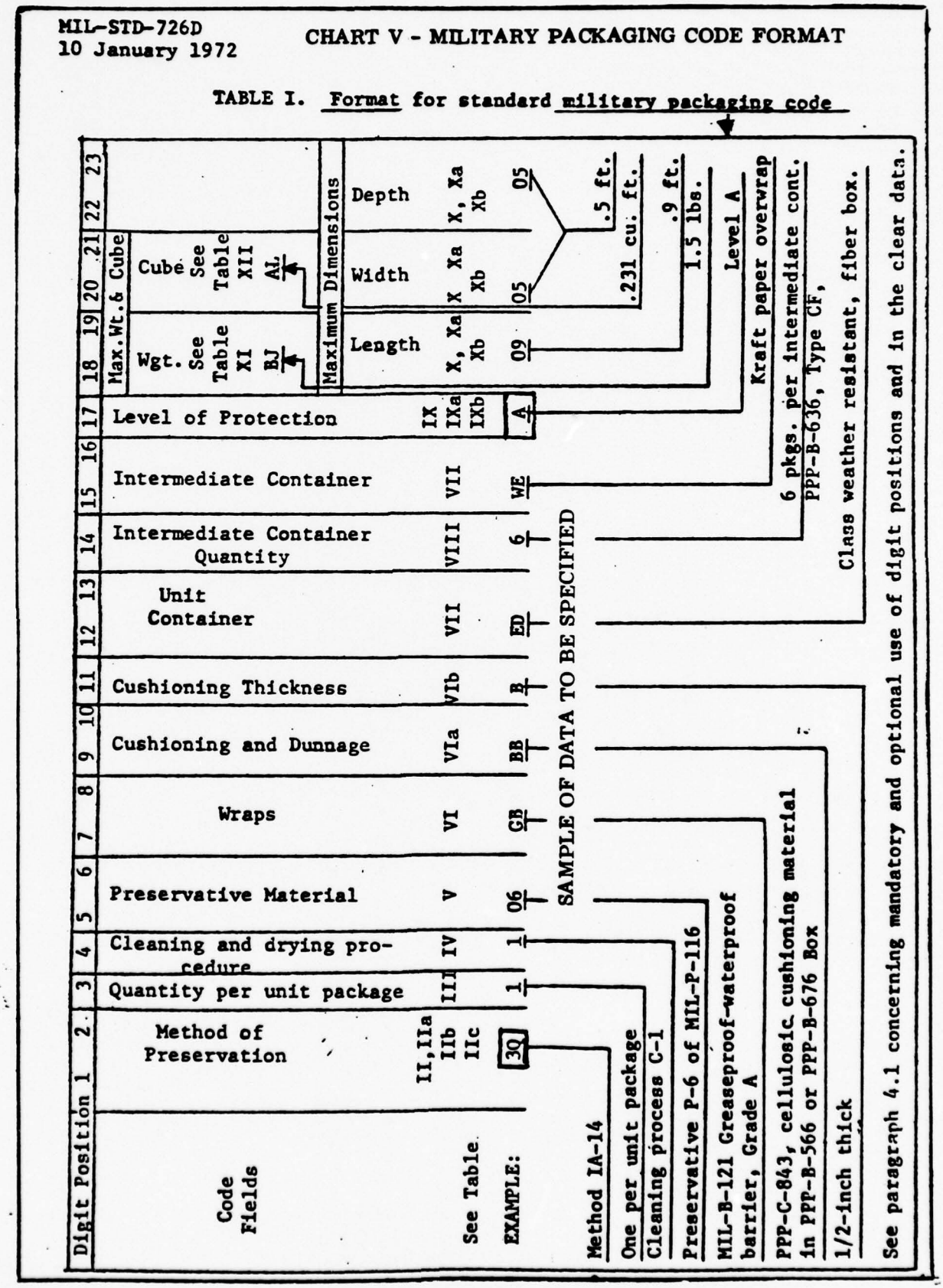
Field Tech Report or Req't for Salvage Action No. and Date	NAEC Part Number or MII-SPEC	Federal Stock Number	Part Name	P. and P. Level	M.P.R. Applicable	Method of Preservation	Type of Preservative	ACTION	
								Effected	Recommended
No Report	613380-2	5RM1720-078-3390	Sealing Strip	A			P-2	Pres. & Pkg.	Adequate
No Report	613380-3	5RM1720-078-3391	Sealing Strip	A			P-2	Pres. & Pkg.	Adequate

** Pres. & Pkg. = Preservation and Packaging.

MIL-STD-726D
10 January 1972

CHART V - MILITARY PACKAGING CODE FORMAT

TABLE I. Format for standard military packaging code



VII REFERENCES

1. NAEC PACKAGING ADHOC COMMITTEE MEMO (enclosed)
2. NAEC CATAPULT SYSTEM COGNIZANCE SHEET (enclosed)
3. NAEC PACKAGING AUTHORIZATION INSTRUCTIONS (enclosed)
4. BRASO PACKAGING AUTHORIZATION INSTRUCTIONS (enclosed)
5. ASO FIELD INSTRUCTION 4030.1D (enclosed)
6. LIST OF MILITARY SPECIFICATIONS (enclosed)
7. CATAPULT OPERATIONS HANDBOOK NAVAIR 51-15AAA-1
8. LIST OF APPLICABLE NAEC DRAWINGS AND M.P.R. (enclosed)
9. TECHNICAL MANUAL, HIGH PRESSURE, CLASS B/BB AIR COMPRESSOR, NAVSHIPS 349-0584
10. TECHNICAL MANUAL, MODEL 0-5AHP, 3500B, TYPE E HOSE, COMPRESSED AIR DEHYDRATOR, NAVSHIPS 338-0347
11. LIST OF APPLICABLE NAVSHIPS DRAWINGS (enclosed)

NF-3:EJH:hat
3 April 1969

MEMORANDUM
From: NF-3
To: Distribution List

Subj: Packaging, Packing and Preservation ADHOC Committee meeting

Ref: (a) Tech Director memo NF-31:CDeC:mlm of 18 Oct 1968

Encl: (1) Outline of Program Objectives, Scope, considerations and committee objectives.
(2) Minutes of last meeting.

1. In accordance with reference (a), the second meeting is scheduled for 18 April 1969, at 0930 in the large conference room, second floor, building 7

2. The agenda for this meeting shall be as follows:

a. Review of minutes of last meeting (Enclosure (2))

b. Discussion of ten (10) IFB's reviewed by Supply Department for adequa of 3P (Preservation, Packaging and Packing) data.

c. Initial discussions concerning alignment of responsibilities within NAEC relative to 3P program elements set forth in enclosure (1).

3. Attendees are requested to come prepared to discuss the agenda items.

E. J. HUNTER

Distribution List
BRASO - T. Haveresm, B-3
C. Ludwig, B-323
Eng. (SI) - W. J. Petransky, NE-52
GSED - E. J. Carreras, SE-521
Ind. Dept. - T. Ellis, NI-23
Supply Dept. - M. McDevitt, AS-7312
H. Solomen, AS-83
J. McGonagle, AS-8313
Qual. Assurance - E. Hunter, NF-3
C. DeCinque, NF-31

Copy to:

B-1	NE	NI-5
B-32	NE-5	SE
AS-7	NF	SE-5
AS-71	NF-1	
AS-8	NI-1	
AS-32	NI-2	

REF-1

A. PROGRAM OBJECTIVES

1. Specify adequate cleaning, preservation, packaging, and packing requirements for all material to be transported or stored such that end-users receive the material in a useable condition. Involved are NAEC procured or manufactured/overhauled material.

2. Establish methods and procedures that will accomplish the desired results with due consideration given to cost effectiveness.

B. ELEMENTS TO BE CONSIDERED

1. Cleaning and drying
2. Method of preservation
3. Preservative material
4. Wraps, cushioning, and dunnage
5. Level of protection
6. Unit and intermediate container
7. Quantity per unit package
8. Intermediate container quantity
9. Allowable maximum weight and cube
10. Shipping container
11. Verification
12. Design considerations

C. SCOPE

1. Under MIL-STD 726, the following different selections exist:

   a. Cleaning - 24 selections

   b. Method of preservation - (procedural specifications) - 305 selections

   c. Wrapping material - 40 selections

   d. Cushioning and dunnage - 82 selections

C. SCOPE (continued)

e. Cushioning thickness - 25 selections

f. Preservative material - 60 selections

g. Level of protection - 3 selections

h. Unit and intermediate container - 264 selections

2. Several hundred detailed and/or general specifications exist on the subject of methods and materials involved with preservation, packaging, and packing. There are 243 references under MIL-STD 726 alone.

D. CONSIDERATIONS

1. Cleaning

a. Compatibility of cleaning materials with items being cleaned.

b. Thoroughness of methods employed.

(1) Supplemental requirements to MIL-Specs.

(2) Cleanliness testing.

c. Special equipment required.

d. Method of cleaning applied

(1) Surface cleaning, mechanical

(a) Grinding

(b) Brushing

(c) Abrasive blasting

(d) Steam or flame jet cleaning

(e) Tumbling

(f) Polishing and buffing.

(g) Vibration .

D. CONSIDERATIONS (continued)

(2) Surface cleaning, chemical

(a) Solvent - soak, spray, degreasing, vapor degreasing, ultrasonic, etc.

(b) Alkaline solutions

(c) Acid baths

(d) Pickling

(e) Descaling, with sodium hydride

(f) Paint stripping or removal

(3) Surface cleaning, electro chemical

(a) Electro polishing

(b) Electrocytic alkaline cleaning

(c) Electrocytic pickling

2. Method of Preservation

a. Proper selection from existing standard methods with due consideration given to:

(1) Storage conditions

(2) Storage periods

(3) Extremes of environmental conditions possible in transit.

(4) Item configuration (projections and sharp corners)

(5) Level of assembly (protection of internal surfaces)

(6) Compatibility of cushioning, dunnage, barrier paper, etc. with preservative compounds

b. Need for specialized or modified methods.

(1) Existing specialized methods per MIL-Spec.

(2) NAEC generated specialized or modified methods.

D. CONSIDERATIONS (continued)

3. Preservative material

   a. Compatibility of compounds with material being preserved

   b. Ease or removal

   c. Possible damage caused by application or removal

   d. Adequacy of protection afforded under anticipated condition

   e. Areas or items not requiring preservation.

4. Wraps, cushioning, and dunnage

   a. Adequacy of protection afforded under anticipated conditions

   b. Special or supplemental requirements.

5. Level of protection

   a. Shipping destination

   b. Storage periods

   c. Criteria for selection

6. Unit and intermediate container

   a. Dessicants

   b. Type

      (1) Bag - burlap, plastic, paper, etc.

      (2) Box - Cardboard, wood, crate, etc.

      (3) Container - plastic, steel, wood, etc. (reusable or throw-awa

   c. Rough handling considerations

   d. Environmental protection

7. Quantity per unit container

   a. Redistribution at stock points.

   b. Size limitations

   c. Weight limitations

D. CONSIDERATIONS (continued)

8. Intermediate container quantity

a. Number of unit packages to be included in an intermediate contain

(1) Redistribution at stock points

(2) Size limitations

(3) Weight limitations

9. Allowable maximum weight and cube

a. National and international regulations

b. Air shipment limitations and regulations

10. Shipping container

a. Storage periods

b. Environmental conditions anticipated

c. Storage conditions

d. Size and weight

e. Identification and marking

11. Verification

a. Preproduction examination

(1) New supplier

(2) New or modified methods employed

(3) Range of testing and inspections required - rough handling, cyclic exposure, methods, materials, workmanship, etc.

b. Conformance inspection

(1) Inspections and tests required

(2) Sampling plans

(3) Lot size formation

D. CONSIDERATIONS (continued)

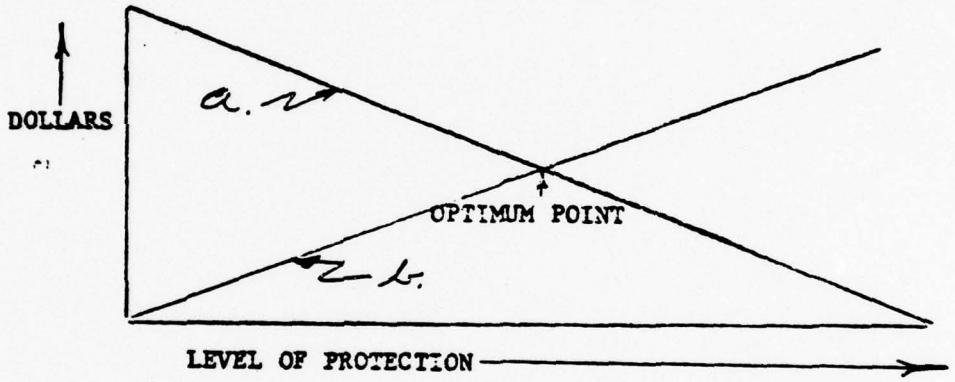
12. Design considerations

a. Corrosion fatigue - salt water corrosion can reduce the endurance limit of steels from 50% to 90% regardless of composition, heat treatment, or original static or dynamic properties.

b. Redesign using corrosive resistant materials or processes may reduce overall cost of item due to reduction of preservation and packaging requirements.

E. COST OBJECTIVES

1. Tangible objective - specify adequate protection at minimum cost



a. Dollar value of material scrapped and repair costs due to deterioration.

b. Cost of cleaning, preservation, packaging, and packing.

2. Intangible objectives - minimum equipment down-time, no interruptions of assigned missions and maximum safety for operating personnel.

a. Above objectives may increase 3-P costs above optimum point

F. AD HOC COMMITTEE OBJECTIVES

1. Assign elements under paragraph B to appropriate departments in the form of a proposal.

2. Determine ways and means of measuring cost effectiveness.

3. Establish procedures for obtaining corrective action when needed.

F. AD HOC COMMITTEE OBJECTIVES (continued)

4. Generate an instruction that sets forth policy, general procedures, and responsibilities.

5. Make recommendations to top management including proposed program operation, assignment of responsibilities, and any organizational changes needed.

6. Review departmental instructions based on station instructions for coverage of all pertinent details.

Minutes of the 25 Nov 1968 Meeting of the Ad Hoc Committee to recommend assignment of responsibilities and setting of policy within NAEC covering preservation, packing and packaging. RETYPED 4/3/69 WITH NI-23 COMMENTS OF 16 DEC 1968 ATTACHED.
The following were in attendance:

Miss M. McDevitt, AS-7312
Mr. H. Solomon, AS-83
Mr. J.McGonagle, AS-8313
Mr. T. Haverson, B-3 HARVERSON
Mr. C. Ludwig, B-323
Mr. W. J. Petransky, NE-52
Mr. E. J. Hunter, NF-3
Mr. C. DeCinque, NF-31
Mr. T. Ellis, NI-23
Mr. E. J. Carreras, SE ~~521~~ 522

1. The meeting was held to discuss present methods and procedures of specifying 3P (preservation, packing and packaging) data with the primary objec being to define problem areas and develop recommendations for improvements the 3P area.

2. Discussion was initiated by having the Industrial Department represent relate how his department handles 3P actions. Following is a summary of the statements presented:

a. The Industrial Department has primary responsibility for specifyi preservation, packing and packaging requirements within all procurements initiated by them. Exceptions would be equipment system wherein an MPR has been prepared as part of the technical data requirements and most SATS equipment that has preservation and packing plus requirements for special shipping containers specified by the Engineering Department.

b. Preservation and ~~packing~~ PACKAGING is specified by the Industrial Department for in-house manufactured or overhauled items and ~~packaging~~ PACKING is specified by the Supply Department Material Division.

c. Each project manager is responsible for specifying (or making sure it is specified) the 3P data for the materials under his control with due consideration given to destination and anticipated storage time and conditions.

d. Represerves and repackages all material in Supply Department stock that requires cyclic preservation. (NAEC INST 4030.1C, PARA. 5.Q

e. Material manufactured for BRASO is preserved and packed per BRASO instructions.

f. TEI's and verbal inputs from Engineering are utilized to clarify or define specific technical considerations such as compatability of a given preservative with hydraulic seals, etc.

g. BRASO furnishes complete information relative to the 3P area for all material they control, whether it is procured or manufactured in-house. They have [redacted] people assigned in this area full time.

h. Supply Department

[redacted]

c. Contract Administration Branch is responsive to inputs from preparers of Purchase Requests to up date, modify and clarify cleaning, preservation, packaging and packing requirements.

5. Engineering Department (SI)

a. Specifies cleaning and 3P requirements for complete systems, such as a MK 7 Arresting Engine, via MPS's and drawing notes. A more complete approach to 3P requirements is conducted under the SATS program wherein specially designed, reusable containers plus detailed requirements relative to cleaning, preservation and packing are specified. In general, no 3P requirements, outside of SATS, are delineated for sub-assemblies and piece parts. Also, no group or individuals are organizationally set up as 3P experts, ON A CONTINUOUS BASIS OTHER THAN SATS.

6. Ground Support Equipment Department

a. Plans to include in the department a 3P "type" desk which will process all Purchase Requests and in-house manufacturing requests to assure adequate 3P requirements are specified.

7. Quality Assurance Division

a. Performs inspection to assure that specified 3P requirements are adhered to, both in-house and at contractors' plants.

b. Submits SCI's or memos to originators of 3P requirements when problems have occured in the past or there is reason to believe what is specified may be inadequate.

[illegible] Other points of discussion

a. A large majority of material must be repackaged at stock points for redistribution in smaller quantities.

b. Carton sizes on containers may help prevent such items as rocks from

pendants, purchase cables and ~~sealing~~ SEALING strips from being stored in such plac as elevator walls where said equipment will deteriorate to the point ~~that~~ THAT becomes unusable.

c. The primary 3P documents utilized at NAEC are MIL-P-116, Methods o Preservation; MIL-STD-726, Packaging Requirement Code; MIL-STD-794, Procedu for Packing and Packing of Parts and Equipment and MIL-STD-163, Steel Mill Products, Preparation for Shipment and Storage. The above specs also refer many lesser specs such as barrier paper, water proof bags, types of boxes, The Material Division suggested that the coding system under MIL-STD-726 be universally employed at NAEC for specifying of packaging requirements. This suggestion was taken under advisement.

d. As an action item, the Supply Department Material Division will review IFB's for a two week period to ascertain that adequate 3P requirement are being set forth by Industrial Department project managers and BRASO. Results of the review will be discussed at the next meeting.

Copy to:

COMMITTEE MEMBERS
A-1
B-1
AD-7
AS-71
AC-8
[illegible]
[illegible]-5
[illegible]
[illegible]-1
[illegible] -2
[illegible]-5
[illegible]
SD-5

REF-1

NI-23:TFE:scc
16 December 1968

MEMORANDUM
From: NI-23
To: NF

I would like to request a few minor changes in the attached minutes. Under paragraph 1.d., this paragraph has a connotation that it might be tied in with Industrial Department. I think it would read much better if we said "Supply Department represerves and packages all materials under their custody that require cycle preservation."

Paragraph 4. - Paragraph 4 lists actions accomplished by Supply Department.

Paragraph 4.a. - Indicates that their Material Section has something to say in our in-house manufacturing. This is not quite true. I think this should read that "Supply Department packages all items that are shipped via NAEC to other activities or destinations." In this paragraph we say they also preserve all raw materials. I think this is covered under paragraph 1.d. al

Paragraph 5.a. - In the next to last sentence, we indicate that SATS equipme delineates 3P requirements down in the sub-assembly area. I do not think th is quite true. What was mentioned at the conference was that we have genera preservation and packaging requirements for SATS systems. But, this does nc go down into the sub-assembly and component level.

Paragraph 6.a. - I have no recollection of the Ground Support representativ saying that they would establish a 3P type desk. Ground Support procurement work the same as all other NAEC procurements. Industrial Department is responsible for ascertaining that procurement instructions contain adequate preservation, packaging and packing instructions. The gentleman from Ground Support noted that he would look into the areas and, in the case of systems or major assemblies, they could possibly follow the MPR route presently in existence for our other major equipments such as MK7, SATS, etc.

Paragraph 7.a. - This paragraph gives the connotation that we actually sent personnel out to literally inspect all pieces under manufacture and in-house This is confusing. I think. It would be more accurate to say that for our in-house manufacture. Inspection Department insures that preservation is accomplished as specified on the manufacturing orders. For our outside proc ments our Quality Assurance people check to ascertain that the contractor i performing within the requirements of his specific contract.

Paragraph 7.b. - Should also read "Based on the Quality Assurance visits to contractor's plants information on problem areas are forwarded back to the requirement originator via trip reports and memos pointing out areas of concern and suggested remedies for such."

REF-1

NI-23:TFE:scc
16 December 1968

Paragraph 8. d. - It was my understanding that Mr. McConagle was to review certain IFB's and to provide us with his opinion as to whether or not the preservation, etc., that was specified is adequate. Since there is no set method for any one requirement, we have to recognize the fact that we are really dealing with the opinion, only, of the person reviewing the procurement.

T. F. ELLIS

INTRODUCTION *

1. PURPOSE OF MANUAL.

This manual contains illustrations and parts lists of replacement components used for maintenance, overhaul, and repair of the following catapults:

Type C Mark 7
Type C Mark 11 Mod 1

This manual is intended as an aid for identification and procurement of all necessary parts for the catapult.

2. SCOPE OF MANUAL.

This manual is divided into three sections and is arranged as shown in the table of contents. Each section has an introductory paragraph explaining the contents, purpose, and use of the section.

3. PERSONNEL RESPONSIBILITY.

The catapult crew is responsible for maintenance duties and replacement of parts when required. All responsible personnel shall read section I carefully to learn how to use this manual. Replacement of parts shall be performed under direct supervision of the catapult maintenance officer. The maintenance officer shall have an intimate knowledge of the catapult, this manual, and all applicable Naval Air Systems Command Catapult Service Bulletins, Service Changes, and Repair Procedures. The catapult maintenance officer is responsible for ordering replacement parts.

3A. COMMAND RESPONSIBILITY.

All items listed in this manual, bridle-arrester manuals NAVAIR 51-5A-502 and NAVAIR 51-5DAA-1, and nose-gear launch manual NAVAIR 51-25-7 are the responsibility of NAVAIRSYSCOMHQ. Technical cognizance is under the Naval Air Engineering Center, Philadelphia, Pa., 19112 to which all communications shall be directed.

The following items are not listed in this manual and are the responsibility of NAVSHIPSYSCOMHQ:

a. Steam supply system from the ship boilers up to but not including the catapult launching valves. (This includes fill, blowdown, and drainage systems.)

b. Steam exhaust system from the catapult exhaust tee to the ship exhaust terminal, but not including the exhaust valve.

c. Catapult trough, trough covers, cover support rails, cylinder foundations, water-brake buttress plate and structure, trough heating, steam smothering system, bridle-tensioner cylinder supports, and nose-gear-launch saddle-plate supports.

d. Piping systems for hydraulic fluid, lubricating oil, air, water supply, water cooling, drains and related supports, and tanks and reservoirs not covered by NAVAIRSYSCOM. (This includes all flexible lines for water-brake supply, water-brake sensing switches, and strip-tensioner lubrication system.

e. Omit per NAEC.

f. Water-brake pumps, feed lines up to the connector on the water-brake cylinder.

g. Drive-system-cable fairleads, sheave guards, and foundations.

h. Electrical wiring, switches, controllers, etc. not covered by NAVAIRSYSCOM.

j. Installation and alinement of catapult, bridle arrester, and nose-gear-launch equipment including suitable access for maintenance.

k. Omit per NAEC.

m. Foundations of retraction engine, bridle arrester, and pump.

Installing and overhaul activities shall refer to NAVSHIPSYSCOM concerning problems on NAVSHIPSYSCOM equipment which involve major modifications, such as piping size, material valve types, controls, and addition or deletion of components. When problems are resolved locally, the NAVSHIPSYSCOM shall be informed of the solution to permit extension to other ships as applicable. Letter reports of operating experience and opinion relative to needed improvements are solicited. Problems, improvement needs, and recommended solutions shall be reported to:

Commander
Naval Ship Systems Command Headquarters
Attn: Code 6648F
Washington, D. C. 20360

Copies to: Commanding Officer
NAEC
Engineering Dept. (SI)
Attn: Code NF-3
Phila., Pa. 19112

and either: Commander Naval Air Force
U.S. Atlantic Fleet
Naval Air Station
Attn: Code 513A
Norfolk, Virginia 23511

* (NAVAIR 51-15AAA-3)

REF.-2

NAVAL AIR ENGINEERING CENTER
PHILADELPHIA, PA. 19112

NAEC 4030.1D
AS:ddm
16 Nov 1970

NAEC INSTRUCTION 4030.1D

From: Commanding Officer, Naval Air Engineering Center
To: NAEC Distribution List No. 12

Subj: Preservation, Packaging, and Packing

Ref: (a) MIL-STD-726A *
(b) NAVSUP PUBLICATION 470 *
(c) NAVSUP Manual, paras. 27055, 27056, 27057 *
(d) MIL-STD- 116E
(e) MIL-B-197D (BEARINGS)
(f) MIL-STD 129E *

1. Purpose. To establish policies for preservation, packaging and packing of material at NAEC.

2. Cancellation. NAEC Instruction 4030.1C of 25 Jul 1966.

3. Definitions.

a. Marking. Numbers, nomenclature or symbols stamped or painted on or otherwise affixed to items or containers for identification during handling, shipment and storage. The term "Marking" shall not be considered to include symbols used for material identification such as color codings or repetitive symbol markings on metals.

b. Preservation and Packaging. Application or use of adequate protective measures to prevent deterioration, including, as applicable, the use of appropriate preservatives, protective wrappings, cushioning interior containers, and complete indentification marking up to but not * including the exterior shipping container.

c. Packing. Application or use of exterior shipping containers and assembling of items or packages therein, together with necessary blocking, bracing or cushioning, weatherproofing, exterior strapping and marking of shipping container.

(1) In the boxing of some items, such as pendant and purchase cables, the package containers are designed to serve also as shipping containers without requiring additional packing. In these cases, the "packaging" and "packing" are the same.

d. Storage. The act of storing or the state of being stored; the keeping or placing of property in a warehouse, shed, or open area. Storage is a continuation of the receiving operation and is preliminary to the shipping or issuing operations.

REF-3

NAECINST 4030.1D
16 Nov 1970

3. Definitions. (continued)

e. Levels of Preservation, Packaging, and Packing. Definitions of these levels are contained in reference (a). Application of proper levels is prescribed in reference (a).

f. Methods. Applicable definitions are shown in reference (d).

4. Policies.

a. All material manufactured and/or overhauled or in storage at NAEC will be preserved, packaged and/or packed to provide protection against corrosion, physical damage and other forms of deterioration during handling, shipment or storage from time of manufacture or overhaul until material is put in use.

b. The requirements established in references (a) through (e) will be followed in determining and accomplishing the amount of preservation, packaging and/or packing required for individual items.

c. Item identification, handling and shipment markings will follow requirements set forth in reference (f).

5. Responsibilities.

a. The Industrial Department will preserve, package and identify all material manufactured or overhauled at NAEC. In addition, the Industrial Department will re-preserve and repackage all Supply Department stock material needing cyclic preservation. Sandblasting is now being performed by the Industrial Department.

b. The Industrial Department will determine type and extent of preservation and packaging to be applied to manufactured, overhauled, and Service Change material.

c. BRASO will furnish complete preservation and packaging instructions for the processing of their material. Packing and marking will be accomplished in accordance with references (b), (f) and ICC regulations by Supply Department (Packing Section).

d. The Quality Assurance Office will perform inspections and have such tests performed that may be deemed necessary to assure that supplies and services conform to prescribed requirements.

e. Supply Department will request the Industrial Department as necessary, to re-preserve and re-package all items in stock needing cyclic preservation.

NAEC 4030.1D
16 Nov 1970

5. Responsibilities. (continued)

f. Supply Department will pack, crate and mark all material shipped from NAEC and construct shipping cases as necessary for package material received from the Industrial Department. Items received from the Industrial Department in accordance with par. 3.c. will not be repacked but will be stenciled with shipping data, etc. All strapping and banding will be accomplished by the Industrial Department prior to forwarding to the Supply Department.

6. Costs. The original preserving, packaging and marking of materials manufactured, overhauled or grouped by the Industrial Department will be charged to the Job Order and allotment that financed its manufacture, overhaul or grouping. All other preservation, etc. will be financed by the appropriate allotment.

C. T. FROSCHER

DEPARTMENT OF THE NAVY
NAVY BRANCH AVIATION SUPPLY OFFICE
CATAPULT AND ARRESTING GEAR
PHILADELPHIA, PA. 19112

B2:JJC:jc
9830/(8927)

5 OCT 1967

From: Officer in Charge, Branch Aviation Supply Office (C&AG)
To: Commander (537), Naval Air Systems Command

Subj: Type M-21 Arresting Gear Spare Parts for Procurement Action; submission of

Ref: (a) NAVAIRSYSCOM ltr AIR-5373C:118:HD of 2 Aug 1967
(b) BRASO ltr B2:JJC:br 9830/(8105) of 8 November 1965
(c) BRASO ltr B2:JJC:dh 9830/(8486) of 10 August 1966

Encl: (1) List of Requirements for Subject Arresting Gear as established during Provisioning Conference.

1. In accordance with reference (a), a conference was convened in the Branch Aviation Supply Office (BRASO) during the period 28 through 31 August 1967, for the purpose of reprovisioning the Type M-21 Arresting Gear. Conferees included representatives of the Naval Air Systems Command (NAVAIRSYSCOM), Naval Air Engineering Center (NAVAIRENGCEN), Naval Air Test Facility (NAVAIRTESTFAC), Marine Corps Auxiliary Landing Field (MCALF), Bogue Field and BRASO.

2. The Branch Aviation Supply Office originally provisioned this equipment during September 1965, under the rationale set forth in reference (b), at which time the M-21 was planned for utilization as part of a SATS complex only. Reference (a) advised that the M-21 is now planned for utilization as an operational arresting gear. Also, that projected plans call for subsequent replacement of other types of emergency runway arresting gear at Naval Air Stations. This provisioning was accomplished on that premise, using the rationale specificed in reference (a).

3. Enclosure (1) represents the results of the conference. It contains the range and depth of shorebased system stocks of spare parts required to support the program set forth in reference (a). Requirements submitted in references (b) and (c) are superseded by the requirements listed in enclosure (1) hereto.

4. The following informational data supplements enclosure (1) and should be supplied by NAVAIRSYSCOM during procurement actions:

B2:JJC:jc
9830/(8927)

5 OCT 1967

a. Items for which Federal Stock Numbers are not listed are in process and will be furnished when available. Contracts negotiated for items not havings FSN's must state that "Federal Stock Numbers and Allocation Instructions will be furnished by the BRASO and no items are to be shipped prior to receipt of this information, without approval of BRASO."

b. Preservation, packaging and packing for all items are to be in accordance with Specification MIL-STD-794 (WP) of 10 March 1965, Method "Level A."

5. Excluded from the provisioning is the M-21 Drive System, for which reference (a) assigns provisioning and supply support responsibility to SPCC, Mechanicsburg.

6. It is requested BRASO be furnished copies of all contracts, amendments thereto, and correspondence relating to procurement of the items listed in enclosure (1).

I. M. KOVAR

Copy to:
CO NAVAIRENGCEN (NI-21)
CO SPCC Mechanicsburg (Code 78321)

B1 (2)
B2
B3
B21 (3)
B22 (3)
BRASO Prov. File
BRASO DF

U. S. NAVY BRANCH AVIATION SUPPLY OFFICE
CATAPULT AND ARRESTING GEAR
U. S. NAVAL AIR ENGINEERING CENTER
PHILADELPHIA, PENNSYLVANIA 19112

B2:JJC:dh
9830/(8683)
7 MAR 1967

From: Officer in Charge, Branch Aviation Supply Office (C&AG)
To: Commander, Naval Air Systems Command (AIR-5573)

Subj: Type E-28 Arresting Gear Repair Parts for Procurement Action; submission of

Ref: (a) NAVAIRSYSCOM 1621072 Nov 1966 not to all

Encl: (1) List of Requirements for subject Arresting Gear as established during Provisioning Conference

1. In accordance with reference (a), a conference was convened in the Branch Aviation Supply Office (BRASO) during the period 14 through 16 February 1967 for the purpose of provisioning the Type E-28 Arresting Gear. Conferees included representatives of the Naval Air Systems Command, Naval Air Engineering Center, All American Engineering Company and Branch Aviation Supply Office.

2. Enclosure (1) represents the results of the conference. It includes the range and depth of shore-based system stocks required to support the program set forth in paragraph 3 below.

3. The following rationale, concurred in by conferees, was employed:

a.	Number of Arresting Gear Units provisioned (each Unit consists of two E-28 engines)	68
b.	Number of fields at which Units will be installed	49
c.	Total arrestations, all units, for one-year period	4500
d.	Quantities of items listed in enclosure (1) are based on the premise of supporting a, b, and c above for a period of one year.	

4. The following informational data supplements enclosure (1) and should be applied by Naval Air Systems Command during procurement actions:

a. Federal Stock Numbers have been requested for all items in enclosure (1). Contracts negotiated must stipulate that Federal Stock Numbers and allocation instructions for these spares will be furnished by the Branch Aviation Supply Office, and that no materials will be shipped prior to receipt of this information without the approval of the Branch Aviation Supply Office.

REF-4

B2:JJC:dh
9830/(8633)

7 MAR 1967

b. Preservation, packaging and packing for all items is to be in accordance with Specification MIL-STD-794 (WP) of 10 March 1965. Method shall be "Level A."

5. Procurement actions should be initiated as promptly as possible in order that spares become available in the supply system consistent with installations and operations of the equipment. It is requested that the Branch Aviation Supply Office be furnished copies of all contracts, amendments thereto and correspondence relating to procurement of the items listed in enclosure (1).

6. Attention is invited that enclosure (1) represents requirements for Type E-28 Arresting Gear, less the Retrieve System. In accordance with agreement reached during the provisioning conference, Naval Air Engineering Center will arrange with Ships Parts Control Center, Mechanicsburg for the provisioning of the Retrieve System, as depicted in NAEL drawing 613494-1.

R. C. BEASTEN
By direction

Copy to:
CO NAVAIRENGCEN Phila. (NI-23) (NE-71)
CO SPCC Mechanicsburg

AD-A054 914 NAVAL AIR ENGINEERING CENTER LAKEHURST N J ENGINEERIN--ETC F/G 1/5
PRESERVATION AND PACKAGING OF LAUNCHER AND RECOVERY SYSTEMS COM--ETC(U)
MAY 78 D BEHMKE, E CAHALL

UNCLASSIFIED NAEC-ENG-7818 NL

2 OF 3

AD A054914

DEPARTMENT OF THE NAVY
AVIATION SUPPLY OFFICE
700 ROBBINS AVENUE
PHILADELPHIA, PA. 19111

FASOINST 4030.1D
SDB2
25 July 1972

ASO FIELD INSTRUCTION 4030.1D

FROM: Commanding Officer, Aviation Supply Office, Philadelphia
TO: Distribution List

SUBJ: CYCLIC INSPECTION AND PRESERVATION OF "R" COGNIZANCE MATERIEL; GUIDELINES FOR

REF: (a) NAVSUP Publication 4105, Subj: LIRSH (List of Items Requiring Special Handling)
(b) BUSANDAINST 4032.3A of 20 Aug 1964, Subj: Care and Preservation of Stocks; policy for
(c) Section C0004, NSL of ASO - Master Repair List
(d) Military Specification MIL-P-116E of 1965, Subj: Preservation, methods of
(e) NAVAIR Pub 15-01-1 and 2 - Preservation, Packaging and Packing of Military Supplies and Equipment
(f) NAVSUP Publication 2002, NSL of Publications and Forms Cognizance Symbol I, Section VIII, Part C
(g) Military Standard 129E of 20 Apr 1970, Subj: Marking for Shipment and Storage
(h) NAVAIRINST 4030.1 of 29 July 1966, Subj: Preservation, Packaging, and Packing of Aeronautical Materiel at Air Stations Having Class "A" Maintenance Facilities; responsibilities and funding for
(i) OPNAVINST 4030.1 of 11 Mar 1971
(j) Military Standard 105, Subj: Sampling Procedures and Tables for Inspection by Attributes

ENCL: (1) Frequency Cycle and Sampling Quantities for Inspection of Preserved Materiel in Stock

1. PURPOSE. This instruction provides current procedures and guidelines for the cyclic inspection and preservation of "R" cognizance materiel.

2. DIRECTIVE CANCELED. FASOINST 4030.1C

3. SCOPE

a. Applies to the Supply Departments of CONUS (Continental United States) air stations.

b. Applies to stocks of "R" cognizance materiel, except items listed in reference (a).

4. BACKGROUND. Guidelines for cyclic inspection, and a frequency cycle and sampling table for the inspection of preserved materiel in stock are contained in reference (b).

5. DEFINITIONS

a. Cyclic Preservation: The represervation, repackaging or repacking of materiel in stores on which previously applied protective measures have matured or deteriorated to a point where renewal of protection is necessary.

b. Cyclic Inspection: The periodic investigation (limited to visual inspection) of materiel condition to ascertain the state of preservation.

6. GENERAL GUIDES AND RESTRICTIONS

a. Materiel in stores which is packaged "Level 'C'" (commercially packaged) or Method III of reference (d) is considered to be safe from deterioration under normal storage conditions. Such materiel will not be subjected to preservation inspection and subsequent represervation.

b. Technical inspection or functional testing for proof of operational readiness, prior to shipment, shall not be performed unless specifically directed by ASO.

c. Prior to shipment, visual inspection of RFI (Ready for Issue) materiels will be conducted as follows:

(1) Unpackaged materiel for assurance of identity, completeness, and freedom from damage. Only materiel which can be inspected without removal of preservation or protective wrappings may be considered to be in this category.

(2) Packaged materiel for adequacy of wrappings, containers, and markings consistent with the need for protection in shipment.

7. ACTION

a. Inspection. All preserved, packaged or packed items listed in reference (c) are subject to the cyclic inspection program and shall be inspected to determine the need for represervation, repackaging or repacking in the frequency cycle and sampling quantities listed in enclosure (1) for the applicable storage condition.

b. Disposition of materiel

(1) All quantities on hand in RFI condition shall be retained.

(2) All quantities on hand in NRFI (Not Ready for Issue) condition, but economically repairable, will be reported to ASO in accordance with existing instructions.

(3) All materiel beyond economic repair will be disposed of in accordance with existing instructions.

c. Preservation, packaging, packing and marking

(1) Unpreserved RFI material in store or returned to store will be preserved, packaged and packed in accordance with references (c), (d), (e), and/or (f).

(2) Preservation and packaging materiels removed from samples for examination to determine the need for preservation shall be replaced or renewed as necessary on items determined to be issuable.

(3) Reprocessing of samples and the lot represented by the samples will not be accomplished merely to bring the preservation and packaging in accord with current requirements.

(4) Marking of all containers will be in accordance with the current issue of reference (g).

d. Materiel not listed in reference (c). When an item under the cognizance of ASO, other than those included in reference (c), is found to be in need of preservation, and/or packaging to prevent deterioration or damage, a NAVSANDA Form 483 (Packaging/Preservation Recommendation) will be submitted to ASO. ASO will advise on quantities to be retained and detail the preservation and packaging procedures for items so reported. However, do not report to ASO small quantities of unpreserved and inexpensive materiel for which preservation would obviously be uneconomical or which will be consumed locally in the forseeable future.

8. FUNDS

a. Expenses for cyclic inspection and necessary reapplication of preservation, packaging and packing resulting from such periodic inspection are chargeable to the appropriated fund specified in references (h) and (i).

b. Supply operating funds will not be used for cyclic perservation of stocks exceeding the guidance indicated in enclosure (1), except when the inspection records and prior experience of the storage activity justify deviations to the frequency cycles and sampling rates.

9. RECORDS. Stocking activities will maintain records of line items inspected, items found to be in need of preservation and other pertinent information that will assist in analyzing preservation inspection cycles and the effectiveness of various types of storage. The inspection records will be used by the stocking activity to provide a basis:

a. For establishing reinspection schedules.

b. For adjusting the frequency of inspection and the sampling rates for the various storage conditions.

c. To determine the relative effectiveness of C/H (Controlled Humidity) storage.

10. FORM CITED. NAVSANDA Form 483 - Packaging/Preservation Recommendation.

Asterisks are not used to indicate changes since this is a general revision.

DISTRIBUTION LIST #
INTERNAL DISTRIBUTION
AUTHENTICATED

H. E. POWELL
LCDR, SC, USN

/s/ T. J. ALLSHOUSE
Captain, SC, USN
Executive Officer

REFERENCE 6

MILITARY SPECIFICATIONS

SPEC. NO.	TITLE
MIL-STD-794C	Parts and Equipment, Procedures for Packaging and Packing of
MIL-P-116E	Methods of Preservation
MIL-STD-726D	Packaging Requirements Code
MIL-STD-129F	Marking for Shipment and Storage
MIL-STD-105D	Sampling Procedures and Tables for Inspection by Attributes
FED. STD. NO. 102b	Preservation, Packaging, and Packing Levels
MIL-HDBK-696	Plastic Coating Compounds, Strippable, Hot and Cold Dip
MIL-STD-758A(SHIPS)	Packaging Procedures for Submarine Repair Parts Utilizing Transparent, Flexible, Heat Sealable Film
MIL-STD-647(ORD)	Packaging Standards, Preparation and Use of
MIL-HDBK-721(MR)	Corrosion and Corrosion Protection of Metals
MIL-STD-753A	Corrosion-Resistant Steel Parts: Sampling, Inspection and Testing for Surface Passivation
MIL-HDBK-304	Military Standardization Handbook Package Cushioning Design
MIL-B-121D	Barrier Material, Greaseproofed, Waterproofed, Flexible

PLATE NO. 11001

SPEC. NO.	TITLE
MIL-B-131E	Barrier Material, Water Vaporproof, Flexible, Heat-Sealable
MIL-P-149B	Plastic Coating Compound, Strippable (Hot Dipping)
MIL-P-2845A	Preservation, Packaging, Packing, and Marking of Main Propulsion Shafting, Bearings, Boat and Ship Propellers, and Associated Repair Parts
MIL-P-3184B	Packaging of Machinery: Deck and Vehicle Mounted with Associated Equipment and Repair Parts
MIL-C-3254B	Coating-System, Bridging, Strippable, Sprayable
MIL-C-6799E	Coatings, Sprayable, Strippable, Protective, Water Emulsion
MIL-P-9024G(USAF)	Packaging, Handling, and Transportability in System/Equipment Acquisition
MIL-C-10382C	Corrosion Preventive, Petrolatum, Spraying Application: for Food Handling Machinery and Equipment
MIL-B-13239E	Barrier Material, Waterproofed, Flexible, All Temperatures, Heat Sealable
MIL-B-22191C	Barrier Materials, Transparent, Flexible, Heat Sealable
MIL-P-45021B	Plastic Coating Compound, Strippable, Cold Dipping, 120° F (49° C)
MIL-C-83933	Corrosion Preventive Compounds Cold Application (for Motor Vehicles)
L-P-375C	Plastic Film, Flexible, Vinyl Chloride
L-P-378D	Plastic Sheet and Strip, Thin Gauge, Polyolefin

SPEC. NO.	TITLE
CCC-C-428E	Cloth, Duck, Cotton; Fire, Water, Weather, and Mildew Resistant
PPP-F-320D	Fiberboard; Corrugated and Solid, Sheet Stock (Container Grade), and Cut Shapes
PPP-B-636G	Boxes, Shipping, Fiberboard
PPP-B-621b	Boxes, Wood, Nailed and Lock-Corner
PPP-B-640d	Boxes, Fiberboard, Corrugated, Triple-Wall
MIL-T-23426A(AS)	Tension Bars Aircraft Launching

REFERENCE 8

MATERIAL & PROCESS REQUIREMENT SPECS.

SPEC. NO.	TITLE
MPR26	Steel: Forged Bars and Billets, and Rough Forgings (Aircraft Launching & Arresting Systems)
MPR39	Wire Rope 1" dia. for Deck Pendants (MIL-W-6015)
MPR41	Strand Gap Quality Control of Wire Rope for E14-1 (1-1/8" dia.) Purchase Cable (MIL-W-6015)
MPR42	Quality Control of Wire Rope (MIL-W-6015A for Purchase Cables excluding 1" dia. and E14-1 Purchase Cable)
MPR400	Graphited Phenolic Material, MIL-P-5431A(AS); Modification of Requirements for Sheets used in Arresting Gear and Catapult Applications
MPR1007	Quality Control for Attaching Terminals by Swaging, Cold Forging and Pressing
MPR1019	Installation and Assembly Instructions for Installing Bearing Races in Aluminum Alloy Sheaves
MPR1024	Instructions for Attaching Phenolic Spacers to Mark 7 Fairlead Sheaves and Mark 7 Engine Sheaves
MPR1028	Quality Control of MK 2 and MK 4 Bridle Arrester Straps
MPR1201	Protective Coating Systems
MPR1262	Preservation, Despreservation and Lubrication of Roller Bearings (Over 6" O.D.) and/or Sheave Sub Assemblies for Launching and Recovery Equipment
MPR1283	Preservation, Packing and Packaging of Mark 2 and Mark 4 Bridle Arrester Straps
MPR1350	Heat Treatment and Stellite Coating of Control Valve Levers, Process for

NAEC DRAWINGS

DWG. NO.	TITLE
53-40112	Spacer Inner and Outer Crosshead and Fixed Sheave
71-40212	Spacer-Inner and Outer Sheave 24 & 28 P.D. CABLE 1-3/8
29-40707	Cable Assy Purchase Retraction Engine Drive System
C87780	Bearing, Roller
A92791	Rope-Wire
317434	Clevis Pin Damper Sheave Cylinder
400790	Socket Eye End 1-3/8 Dia. Cable Terminal
408402	Sleeve Valve Stem Constant Runout Valve
A414240	Nut, Union Unions and Straight Pipe Thread Adapter
501549	Lever Upper Ratio
504047	Cap Assembly Cylinder Damper End Damper Sheave Cylinder
504130	Rod-Piston Cylinder Assembly Cable Anchor Damper
504821	Strap Assembly
509185	Sheave Assembly Cemented Phenolic Spacer 1-3/8 Cable 28PD
509979	Valve, Relief Through Flow "O" Ring Seal Type
512513	Track Wide Profile Impact Resisting
515659	1-7/16 Dia. Purchase Cable and Stowage Reel Assembly
613101	Piston Assembly Launching Engine Long Guide
613102	Piston Assembly Launching Engine Long Guide
613380	Strip Cold Drawn Sealing, Launching Cylinder

REFERENCE 11

NAVSHIPS DRAWINGS

DWG. NO.	TITLE
S4900H1332052G	CVA 62 Arrg't. of Ships Serv. Compressed Air System, Main Dk. and above Aft. Fr. 132
513-1683281P	CVA 63 Arrangement of Ships Service Comp. Air System below 4th Deck
513-168382H	CVA 63 Arrangement of Ships Service Comp. Air System 4th Deck
513-1683289D	CVA 63 Diagram of H. P. & Aviation Service Air Systems-1st Platf. to Main (Hangar) Dk. & Material Schedule
513-1683290G	CVA 63 Diagram of H. P. & Aviation Service Air Systems-01 Level to Flight Dk. (04 Level) & Elevation
513-1683291E	CVA 63 Diagram of Ships Service Air System (100 PSI) 01 Level & above & Elevation

APPENDIX INDEX

APPENDIX A
REPLY LETTERS FROM GOVERNMENT AGENCIES

DEPARTMENT OF THE ARMY
HEADQUARTERS TOBYHANNA ARMY DEPOT
TOBYHANNA, PENNSYLVANIA 18466

IN REPLY REFER TO

AMXTO-TP-P

Mr. A.W. Volk
National Designers, Inc.
7801 Airport Highway
Pennsauken, NJ 08109

Dear Mr. Volk:

In response to your 12 October 1972 letter Mr. Samuel Bellanco may be contacted in regard to new preservation and packaging materials development. Mr. Bellanco may be reached by calling Area Code (717) 894-8301.

Yours truly,

for N.J. DeMARS
Director
AMC Packaging, Storage,
and Containerization Center

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR FORCE LOGISTICS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433

27 OCT 1972

DSP

Navy Contract N00156-72-S-0009 (Your Ltr, 12 Oct 1972)

National Designers, Inc.
ATTN: Mr. A. W. Volk
7801 Airport Highway
Pennsauken, New Jersey 08109

1. The Materials Division of the Air Force Packaging Evaluation Agency has two programs underway which may be of value in your study of preservation and packaging techniques for catapult components. We are now investigating various water vapor barriers for corrosion protection and are deeply involved in polyurethane foam-in-place packaging techniques.

2. If you wish to discuss either of these programs in detail, please contact Mr. Paul Robbins, AFLC/DSPS, Wright-Patterson AFB, Ohio 45433, telephone A/C 513-257-4292 or 257-3734.

JACK E. THOMPSON
Deputy Director of Packaging
Office of DoD Distribution

Cy to: Naval Air Engrg Center
Philadelphia PA 19112

DEPARTMENT OF THE ARMY
U S ARMY NATICK LABORATORIES
NATICK, MASSACHUSETTS 01760

IN REPLY REFER TO

AMXRE-GPK

2 NOV 1972

Mr. A. W. Volk
National Designers, Inc.
7801 Airport Highway
Pennsauken, New Jersey 08109

Dear Mr. Volk:

These Laboratories have had no experience in the preservation or packaging of catapult components.

One of the latest developments that may be of interest to you is the foam-in-place packaging using polyurethane foam as a blocking and cushioning media. Similar information may be received from Mr. Joseph Brugh, Director, Naval Logistics Group, Cheatham Annex, Virginia.

These Laboratories have evaluated many laminates for flexible packages. Information may be received by contacting any of the following personnel of the General Equipment & Packaging Laboratory:

Mr. Frank J. Rubinate, Chief, Packaging Division
Dr. Rauno Lampi, Chief, Systems Development Branch
Dr. Leslie McClaine, Chief, Engineering Sciences Division.

Mr. Guy Schrag and Mr. Macy of the Clothing & Personel Life Support Equipment Laboratory, also of these Laboratories, are also possible sources of information on paper, paper products, plastics and films respectively.

Sincerely yours,

FERDINAND L. TROISI
Packaging Technologist
Applied Technology Branch
Packaging Division
General Equipment & Packaging Laboratory

DEPARTMENT OF THE ARMY
U S ARMY NATICK LABORATORIES
NATICK, MASSACHUSETTS 01760

IN REPLY REFER TO

AMXRE-GPK

16 AUG 972

Mr. A. W. Volk
National Designers, Incorporated
1219 Vine Street
Philadelphia, Pennsylvania

Dear Mr. Volk:

The Symposium referenced in your letter dated 14 August 1972 will be devoted to the exchange of ideas, technical information, and programs within the Military. Industry participation is not anticipated.

Your interest in the Symposium is appreciated.

Sincerely yours,

FRANK J. RUBINATE
Chief
Packaging Division
General Equipment & Packaging Labor

DEFENSE SUPPLY AGENCY
DEFENSE DOCUMENTATION CENTER
CAMERON STATION
ALEXANDRIA, VIRGINIA 22314

DDC-TSR-2
Case No: 7304.1041

30 Oct 72

Mr. A. W. Volk
National Designers, Inc.
1209 Vine Street
Philadelphia, Pennsylvania 19107

Dear Mr. Volk:

Reference is made to our telephone call to your office on 27 Oct 72 regarding your letter of 12 Oct 72.

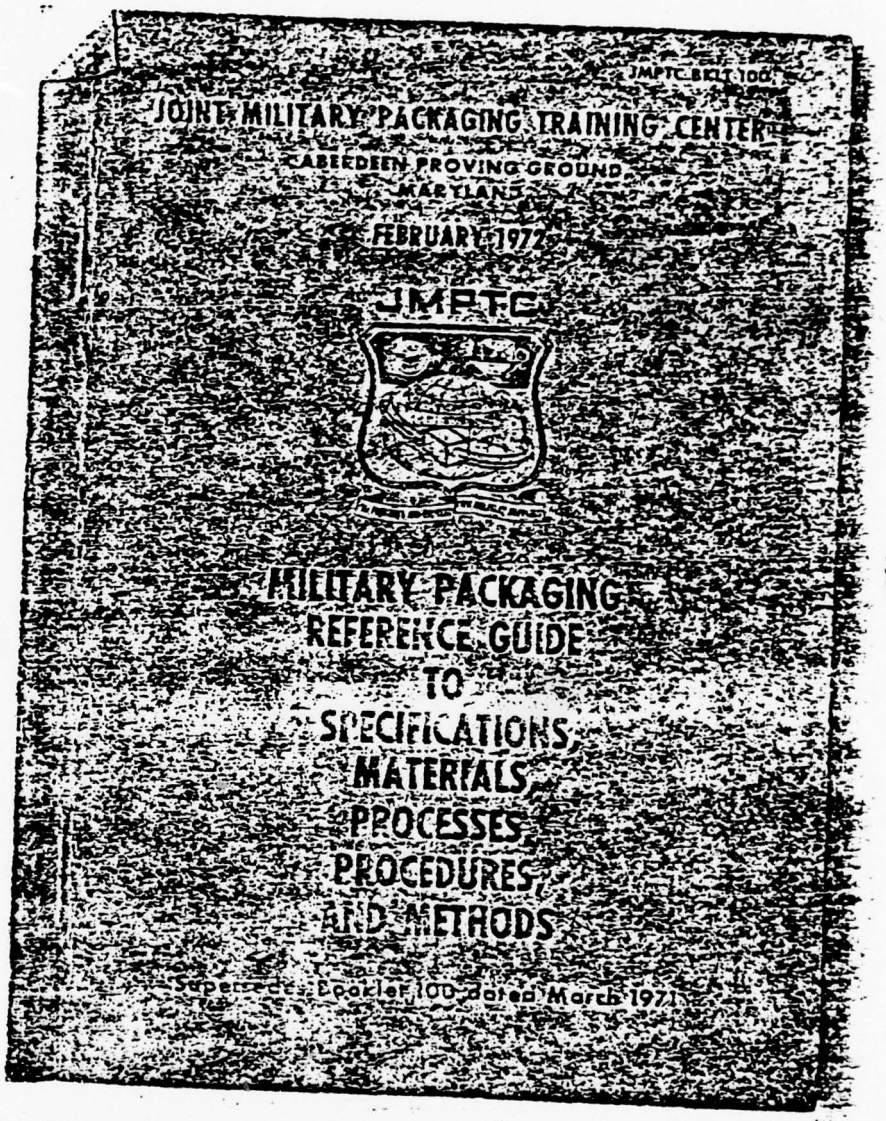
DDC is authorized to provide its services to organizations engaged in research and development under a U.S. Government contract or grant and registered to receive DoD scientific and technical information. Since the reports of interest to you are required in connection with Navy contract N00156-72-A-0009, your organization appears to be eligible to register. If so, please read carefully and follow the instructions in the enclosed DSAM 4185.3.

Upon receipt of a properly executed DD Form 1540 and DD Form 1541 (requi for classified service) in DDC, your organization will be registered for service. At that time, you will be sent a kit containing instructions and forms for use in requesting service.

Sincerely,

DAVID L. WILLIFORD
Chief, Reference
Services Branch

4 Encl
1. NTIS Brochure
2. DDC Brochure
3. DD Forms 1540 & 1541
4. DSAM 4185.3


JMPTC SKILL 100
JOINT MILITARY PACKAGING TRAINING CENTER
ABERDEEN PROVING GROUND
MARYLAND
FEBRUARY 1972
JMPTC
MILITARY PACKAGING
REFERENCE GUIDE
TO
SPECIFICATIONS
MATERIALS
PROCESSES
PROCEDURES
AND METHODS
Supersedes Booklet 100 dated March 1971

National Designers, Inc.

7901 Airport Highway Pennsauken, N.J. 08109

Phila., P

New Jerse

10 October 1972

Dept. of The Army
Joint Mil. Pkg. Tng. Center
Aberdeen Proving Gr., Md. 21005

Attn: AMXPT-S

Gentlemen:

We are currently making a study of preservation and packaging catapult components for N.A.E.C., U.S. Naval Base, Philadelphia, Pa., under contract N00156-72-A-0009.

In conjunction with the study, we would appreciate receiving six (6) copies of your latest issue of your Military Packaging Guide JMPTC BKLT 100 to use as a reference. Further, if you could advise us of the person within your facility who heads up your Packaging and Laboratory group, that we could contact in regards to development of new techniques or methods for preservation and packaging of metallic parts.

Thank you for your cooperation.

Sincerely yours,

A.W. Volk

A.W. Volk

AWV/wj

APPENDIX B

PACKAGING DEVELOPMENT SOURCES AND REPORTS COMMERCIAL AND MILITARY

B-1 Modern Packaging, McGraw-Hill Publishing, 1221 Avenue of America, New York 10020 (212 897-1221), Modern Packaging Encyclopenia

B-2 Package Development, Scarborough Publishing Company LTD, P.O. Box 225, Briarclife Manor New York 10510

B-3 Package Engineering, A.J. Ray Publishing Division, Cahners Publishing, 55 Wabash Avenue, Chicago, Illinois, 60603

B-4 Packaging Design, R.C. Publishing, 19 West 44th Street, New York 10036 (212 682-0830)

B-5 Packaging Digest, Penton Publishing Company, Penton Plaza, 1111 Chester Avenue, Cleveland, Ohio 44114

B-6 Packaging & Shipping, Bonnell Publishing 437 East 5th Street, Plainfield New Jersey

B-7 Official Container Directory, Magazine for Industry, 777-3rd Avenue New York 10017 (212 838-7778)

B-8 The Packaging Institute, U.S.A., 342 Madison Avenue, New York 10017

B-9 The Engineering Index Annual, Engineering Societies Library 345 E. 47th St. N.Y., N.Y. 10017

B-10 Technical Abstract Bulletin, Annual Index Department of Defense Defense Documentation Center Cameron Station, Alexandria Va. 22314

APPENDIX B-1A

MODERN PACKAGING
GENERAL INDEX AND GUIDE

TYPICAL REPORTS LISTED

PACKAGING

Coatings, Waxes

1. Comparing coatings
2. More on coatings vs. laminations

Flexible Films, Resins

1. Permeation through plastics
2. Pinhole resistance of flexibles

Foam, Cushioning Materials, Liners

1. Combinations with foam problem-solving packages
2. New cushioning foams for packaging applications

Cartons

1. Comparing coatings
2. Packager for hardware

Corrugated

1. Foam-in-place system simplifies cushioning job

Shows & Seminars

1. Ecology is still Topic "A"
2. Ocean-hopping for new ideas

Technical, Engineering, Research, Testing

1. Enter polybutylene film
2. Inhibiting can rust
3. Package specification
4. Space efficiency of shapes
5. Testing for akaline reaction

APPENDIX B-2A

PACKAGE DEVELOPMENT EDITORIAL INDEX

TYPICAL REPORTS LISTED

PACKAGING

Cushioning

1. Determine product fragility before designing the container. July/Aug p. 14

Design

1. How to develope innovative package design concepts. July/Aug p.3

Flexible Packaging

1. Tailored packaging properties with new alloying processes. July/Aug p. 23
2. Predicting material behavior thru accelerated storage testing. Jan/Feb p. 13

Testing

1. Determine product fragility before designing the container. July/Aug p. 14
2. Basic concepts of package testing need re-examination. May/June p. 5
3. How to use supplier provided engineering and testing services. May/June p. 31
4. How to pre-determine packaging system adequacy and assure quality control. Jan/Feb p. 5

APPENDIX B-3A

PACKAGE ENGINEERING
CUMULATIVE EDITORIAL INDEX

TYPICAL REPORTS LISTED

PACKAGING

Cleaning

1. Cleaning fluid strips unwanted coatings from machine parts

Coatings

1. New nylon coming for coatings, adhesives and co-extrusion
2. Prevents wear on machine parts

Containers

1. New case, interior pieces hold heavy contents intact but use less material
2. What's ahead in thermoforming containers

Costs, Packaging

1. Styrene foam plus corrugated cuts costs, gains space by Anthony LaMendola

Environment

1. Moon-trip ideas help control your packaging environment

Films

1. Film protects metal from rust, corrosion
2. Packaging materials in action: the outlook for the 70's

Functional Packaging

1. Get at crate's contents without dismantling crate by John D. Kroll

PACKAGE ENGINEERING
CUMULATIVE EDITORIAL INDEX
(Cont'd)

Marking Equipment

1. What's ahead in code marking and imprinting. See also: Coding equipment; Imprinting equipment; Packaging operations/techniques; Printing equipment

Military Packaging

1. Army packaging research generates know-why for industry

Package Development/Engineering

1. Disposability: big, new challenge for packaging management
2. Purchasing/package engineering team wraps up specs in one system by W. F. Musgrove and James Field
3. What happens to the package in transportation?

Research and Development

1. Rapid method of finding water vapor transmission rates by Morris W. Kane

Transportation

1. It's time we pool our efforts to learn what happens to packages during transportation--so we can specify exact protection
2. 1969 SPHE national symposium

APPENDIX B-8A

THE PACKAGING INSTITUTE, USA
TECHNICAL REPORTS
1972 EDITION

TYPICAL REPORTS LISTED

PACKAGING RESEARCH AND DEVELOPMENT

"Forecast in Packaging"; Dr. E. A. Nebesky and M. S. Peterson; F-1966 #F-6627

"New Concepts in Shrink Film Packaging"; W. A. Foster, Jr.; F-1964 #F-6415

"Industrial Shrink Packaging: Pallet and Bundle Pack"; N. B. Potter; F-1969 #F-6945

"Skin Packaging of Industrial and Consumer Products"; H. G. Kraut; F-1964 #F-6425

"Future of Plastics in Rigid Packaging"; Dr. R. W. Finholt; F-1969 #F6916

"Plastic Packaging Materials"; G. E. Pickering; F-1965 #F-6530

"New Plastics, New Packages: Prospects for the '70s"; M. S. Thompson; F-1970 #F-7040

APPENDIX B-9A

ENGINEERING INDEX-1970 VOL. 69 ANNUAL

TYPICAL REPORTS LISTED

PACKAGING

How to cope with military specs; Anon; Modern Packaging v 42 n 9 Sept. 1969 p 103-5; Military packaging, in its broadest scope, includes—product preservation, packaging in unit wraps, cartons, etc, packing in shipping containers, marking and identification and utilization, such as palletization and/or containerization. Basic literature and information sourdes, implementation of package changes from those specified, and procedures to follow before and after bidding are discussed. 14557

Army R&D's packaging innovations; M.S. PETERSON: Food Eng v 41 n 3 Mar 1969 p 126-8, 130; Notes on progress of packaging projects at US Army Laboratories, Natick, Mass. These include—refinment of the Natickometer Recorder, which records environmental and shipping stresses required for container design criteria; improving the palletization and containerization of supplies; establishing the reliablity of flexible packages for thermoprocessed foods; developing insulated containers for carring hot food on extended missions, etc. 24605

How to pack the package; S. BERNSTEIN (Quaker Export Packaging Co. Philadelphia, Pa.) Product Assurance Conference & Technical Exhibit—Trans, Hempstead, NY, June 7-8 1968 p 135-6; It is pointed out that packaging engineering function must be considered from a theoretical as well as pragmatic point of view, by the contractor and the customer. There are significant points in the life cycle of a system wherein packaging engineering can have an impact on effectiveness and cost. However, the impact can only become a reality when packaging engineering data and concepts are applied effectively on an overall technical and economical aspect of the desired system output. 34930

Packaging for environment; A. SANDLER (General Instrument Corp, Hicksville, NY); Produce Assurance Conference & Technical Exhibit—Trans, Hempstead, NY, June 7-8 1968 p 141-6; Some of the basic environments encountered by instruments during both the "shipping" and "use" periods are identified. Methods of countering a number of these environments are suggested. 41867

Flexible packaging rocks the 'establishment'; Anon; Mod Packag v 42 n 10 Oct. 1969 p 124-33; Considerations of new materials/machine concepts which lure management with offers of methods that open up new profit options, economize on plant, inventory and shipping space, and counter inflation by helping solve labor problems. Shrink pallets concept, its performance and application possibilities. Wide diversity of shrink casing and wrapping in packaging industry. Overwrapping with attention paid to sizing up specilized wrappers. Packaging lines comprising forming, filling and sealing operations. Economic aspects of recent development in packaging field. 51803

Point of departure in development of shipping packaging. The development of these packagings is influenced by various factors. The most important ones are protective properties against shipping and storage strains. Ease of packaging the product with machines, ease of handling and opening the package, and sales appeal of the package are some other requirements. The author deals comprehensively with all aspects in connection with the development of shipping packagings which gains increasingly in importance. 51863

Packaging management. No longer a bit part; Anon; Mod Packag v 43 n 2 Feb 1970 p 82-5; Considerations of new approach to duties and responsibility of managers in the packaging industry. Report is prepared on opinions of many executives from among industrial management. 56167

Costs. See also Packaging Materials—Plastics.

World packaging prices go up; Anon; Mod Packag v 43 n 4 Apr 1970 p 133-6; Economic considerations related to the present situation and development trend on the world's market with particular attention paid to influence of war, inflation and labor costs which are felt everywhere. Statistical figures are presented which show that international flow of materials and containers grows. Some economic data for the United States and other countries are tabulated. 56737

APPENDIX B-10A

DEFENSE DOCUMENTATION CENTER TECHNICAL ABSTRACT BULLETIN ANNUAL INDEX FOR 1970

TYPICAL REPORTS LISTED

PACKAGING

Antitank Ammunition
TOW Container Redesign.
AD-875 470L 70-23 Fld/Gp 13/4

Automatic
Process Improvement for 105 mm Automated Propellant Bag Loading.
AD-871 393L 70-16 Fld/Gp 13/8

Bibliographies
Packaging (Ordnance). Volume III.
AD-508 100 70-10 Fld/Gp 13/4

Cargo
Air Transport (Suitability of Equipment for).
AD-866 647 70-9 Fld/Gp 13/4

Cartridges
Product Improvement Test of Package for Cartridge, 81-mm, M301A2 and M301A3.
AD-872 554L 70-19 Fld/Gp 13/4

China
China Packaging Institute--Translation.
AD-863 610L 70-5 Fld/Gp 13/4

Czechoslovakia
Twenty Years of Packaging Research in the Czechoslovak Socialist Republic -- Translation.
AD-861 689L 70-2 Fld/Gp 13/4
Problems of Packaging in Czechoslovakia -- Translation.
AD-871 571L 70-17 Fld/Gp 13/4

DEFENSE DOCUMENTATION CENTER
TECHNICAL ABSTRACT BULLETIN
ANNUAL INDEX FOR 1970
(Cont'd)

Food
Engineer Design Test of Flexible Packages for Heat Processed Foods - Fruitcake and Date Pudding.
AD-863 888L 70-5 Fld/Gp 6/8
Engineer Design Test of Flexible Packages for Heat Processed Foods - Beans, Green; Corn, Whole Kernel; Chicken a la King.
AD-863 889L 70-5 Fld/Gp 6/8

India
The Most Common Hazards, Defects and Damages of Packaging when Transported and Stored in India -- Translation.
AD-867 767L 70-11 Fld/Gp 13/4

Machines
Sandbagging Systems.
AD-876 008L 70-24 Fld/Gp 13/4

Management Engineering
The Characteristics of a Military Packaging Management Information System.
AD-863 950 70-5 Fld/Gp 13/4

Ordnance
Packaging (Ordnance) Volume II.
AD-867 200 70-10 Fld/Gp 13/4

Scientific Research
Research on Packaging -- Translation.
AD-861 199L 70-1 Fld/Gp 13/4

Sealing Compounds
Effect of Semkit Packaging on Sealants: EC5106 B$\frac{1}{2}$ and EC5123 B2.
AD-862 448L 70-3 Fld/Gp 13/4

Small Arms Ammunition
Caseless Ammunition Packaging Program.
AD-864 527L 70-6 Fld/Gp 19/1

DEFENSE DOCUMENTATION CENTER
TECHNICAL ABSTRACT BULLETIN
ANNUAL INDEX FOR 1970
(Cont'd)

Standardization
Containerization, Its Necessity and the Possibilities of Developing it -- Translation.
AD-863 620L 70-5 Fld/Gp 13/4

USSR
Development of a Specialized Packaging Production in the Soviet Union -- Translation.
AD-862 918L 70-3 Fld/Gp 13/4

PACKING MATERIALS

Environmental Tests
Development and Evaluation of a Packaging System for MK 4 Mod O Smoke Canister.
AD-862 278L 70-3 Fld/Gp 13/4

APPENDIX C

PRESERVATION AND PACKAGING SPECIFICATIONS TABLES (EXCERPTS)

TABLE II. CHEMICAL AND PHYSICAL CHARACTERISTICS

BARE METALS (NON-ELECTRICAL)	PLATED COATED SURFACE (NON-ELECTRICAL)	NONMETAL (NON-ELECTRICAL)	ELECTRICAL INSTRUMENTS AND EQUIPMENT	
			Sealed	
Iron, steel Includes all stainless varities except those having minimum compositions of 17Cr-7Ni. CP.01, 02, 03, 04, 05, 06, 07, 08	Iron or steel fully plated with: chromium, copper, nickel, silver, tin, gold, iridium, osmium, palladium, rhodium, or ruthenium CP.23, 24, 25, 26	Plastics or fiber CP.39 [1] Protect water, fungus CP.40	Contains any material but no component parts of equipment CP.54	
MAGNESIUM CP.09, 10, 11, 12, 13, 14	Ferrous metals (iron or steel) fully plated with zinc, cadmium, lead or tarne: Nonferrous metals (other than iron or steel) that have been plated CP.27, 28, 29, 30	Natural or synthetic rubber CP.41 With optical glass protect fungus growth CP.42	Not Sealed	
Beryllium Nickel Brass Cobalt Bronze Silver Cadmium Stainless Steel Copper Titanium Lead Tin Zinc Monel Rough Copper Alloy Castings Sintered Copper Alloys CP.15, 16, 17, 18	Iron, steel, magnesium, copper or brass which have parkerized, bonderized, blued dichromate or black oxide finish over entire surface CP.31, 32, 33, 34, 35, 36	Leather Small amount mold permitted CP.43 No mold permitted CP.44	Steel, iron and magnesium CP.55, 56, 57, 58	
Aluminum Babbitt Porous Steel CP.19, 20, 21, 22	Anodized aluminum, magnesium or zinc; zinc-plated iron or steel, zinc alloy castings or magnesium to which chromate coatings have been applied; alclad aluminum CP.37	Optical glass, quartz, mica and assemblies using these as component parts. Protect from fungus growth CP.45	Optical glass, quartz and mica CP.59	
	Metals that are painted, varnished, lacquered or enameled CP.38	Carbon, graphite, asbestos, ceramics and glass (other than optical) CP.46	Copper, bronze, brass, beryllium CP.60	
		Paper wood or cork Protect from physical damage CP.47, 48 Protect from oil or water CP.49, 50	Gold, silver, platinum and iridium and other precious metals CP.61	
		Cordage and items made of cloth Treated CP.51 Not treated CP.52	Parts move on bearings (any material) CP.62	
		Textiles Protect from shrinkage, decay, etc. CP.53	Parts electrically balanced or calibrated	Bare steel, iron or magnesium CP.63
				Other CP.64
			Metals that are varnished, lacquered, or given other equivalent protective coatings CP.65	
			Metals which have parkerized, bonderized, blued, dichromate or black oxide finish over entire surface. Include nonmetallic combinations CP.66, 67	
			Not made of bare steel, iron, or magnesium, not made of bare silver, copper, bronze, beryllium optical glass, quartz, or mica CP.68	
			End product may contain any material CP.69	

Use of Tables for preservation method determinations

(a) Table II - Locate item in proper category (Bare metals, etc.) and in division within category (iron, steel, etc.). Check group numbers in Table III to ascertain which group no. description adequately fits the item.

(b) Table III - When specific group is determined specify the basic preservation method for that group.

(c) Table IV - This table is intended to give guidance for the development of submethod and packaging requirements based on such factors as size, weight, and fragility.

(d) Table V - Implement the information in Table IV within the limitations of this standard.

TABLE III. GROUP DESCRIPTIONS LEADING TO BASIC MIL-P-116 METHODS

Bare metals

	Iron, Steel								Magnesium						Beryllium, Brass, etc.				Aluminum, etc.			
(CP)	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22
Contact preservative:					P	P	P	P			P	P	P	P	P	P	P	P				
Surfaces or application:			C	C			C	C			C	C					C	C			C	C
Combination with nonmetallic material:		Y		Y		Y		Y		Y		Y		Y		Y		Y		Y		Y
Preservation method:	1	1	1C	1C	1C	1C	11	11	1	1	11	11	11	11	111	111	1C	1C	1	1	1	1

Plated coated surfaces

	Iron, Steel, Chromium Plated, etc.				Ferrous, Zinc Plated, etc.				Iron or Steel, Perforated, etc.						Anodized Aluminum, etc.	Metal Painted, etc.
(CP)	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
Contact preservative:	P	P	P	P	P	P	P	P	P	P	P	P			P	P
Surfaces or application:	C	C					C	C			C	C	C	C		
Combination with nonmetallic material:		Y		Y		Y		Y		Y		Y		Y		
Preservation method:	1C	1C	111	111	111	111	1C	1C	111	111	1C	1C	1	1	111	111

Nonmetals

	Plastic or Fiber		Rubber		Leather		Optical Glass, used in Parts	Carbon Graphite, etc.	Paper, Wood or Cork				Cordage, Cloth Rope		Textile
(CP)	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53
Surface or application:						C									C
Preservation method:	111	1C	1C	1C	111	1C	1C	111	111	1C	111	1C	111	1C	1C

Electrical Inst. & Equip.

	SEALED AGAINST WATER		NOT SEALED AGAINST ENTRANCE OF WATER													
	ANY MATERIAL No. Components of Equipment	Steel, Iron, Mag.			Optical Glass, etc.	Copper, etc.	Gold, etc.	Parts Movable on-Bearing	Parts Elect. Sol.		Metals Varnished	Metals Perforated		No Bare Metal, etc.	End Product Any Mat'ls
(CP)	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69
Contact preservative:	P	P	P			P	P	P	P	P	P	P	P	P	P	P
Surfaces or application:			C	C		C			C							
& Movable parts:									MP	MP	MP		MP	MP		
Preservation method:	111	11	11	11	11	1C	1C	1C	1C	1C	1C	111	1C	1C	111	11

CONTACT PRESERVATIVE	SURF. OR APPL.	COMB. NONMETAL MAT'L	MOVABLE PARTS
P - PROHIBITED	C - CRITICAL	Y - COMBINED	MP - HAS MOVABLE PART
BLANK - PERMITTED	BLANK - NOT CRITICAL	BLANK - NOT COMBINED	BLANK - NO MOVABLE PART

APP. C
2

MIL-P-116E

METHOD I

Preservative coating applied. Wrapper not sealed. Water as liquid or vapor and corrosive atmosphere has relatively free contact with the preserved part.

METHOD I A

Preservative coating applied as required. Water-vaporproof barrier sealed. Only traces of water-vapor penetration to part possible.

METHOD I B

Part, wrapped or unwrapped, enclosed within coating of strippable compound. No penetration of liquid and only traces of water-vapor to part.

METHOD I C

Preservative coating applied as required. Waterproof or water-resistant barrier sealed. Only water-vapor penetration to preserved part.

METHOD II

Preservative coating applied as required. Waterproof, water-vaporproof barrier sealed. Only traces of water-vapor penetration to part and this is adsorbed by desiccant.

METHOD III

No additional preservative on part. Packaged for physical and mechanical protection only. Relatively free access of liquid or water-vapor to part.

	Part or assembly		Waterproof barrier, sealed
	Preservative		Waterproof, water-vaporproof barrier, sealed
	Desiccant, adsorbing moisture		Water vapor
	Unsealed wrapper		Rain, salt spray, etc
	Mechanical or physical protection		Strippable compound

Figure 1. - Methods of Preservation

TABLE III. *Schedule of Acceptance Tests and Visual Inspection Aids*

Preservation and Packaging Method	Determination of absorbent (see 4.4.1)	Preservative Compounds Application (see 4.4.2)	Vacuum Chamber Test (see 4.4.3.2 & Note 1)	Heat Seal Test (see 4.4.4)	Cycle Exposure Test (see 4.4.5)	Rough Handling Test (see 4.4.6)	Marking and Labeling (see Note 2 and Para. 5.3)	Workmanship (see Note 3 and Paras. 5.1.2, 5.6 and 5.7)
Method 1	Required as applicable	Required	.....	.....	.....	See Notes 11 and 12	Label on initial wrap and on container when used. (Identification not required on greaseproof wraps placed in snug containers where identification is on the container).	1. Minimum air void inside package. 2. No damage of preservative by excessively tight wrap. 3. Cushioning or blocking as required.
Method 1A-5	Required as applicable	Required when preservative is used	Required (See Note 8)	.....	See Notes 6 and 12	See Notes 11 and 12	Markings applied directly on metal containers.	1. Minimum air void. 2. If additional protection other than basic wrap is needed for protection, cushioning or blocking should be used.
Method 1A-6	Required as applicable	Required when preservative is used	Required	.....	See Note 6	See Note 11	Markings applied directly on metal containers.	1. Container of appropriate size for item with room for expansion of preservative.
Method 1A-8	Required as applicable	Required when preservative is used	Required (See Note 8 and 9)	Required	See Notes 6 and 12	See Notes 11 and 12	Marking applied on bag and on container when used.	1. Appropriate size bags. 2. Minimum air voids. 3. Cushioning as required.
Method 1A-13	Required as applicable	Required when preservative is used	Required (See Note 8)	.....	See Notes 6 and 12	See Notes 11 and 12	Markings applied on container.	1. Minimum air void. 2. If additional protection other than basic wrap is needed for protection, cushioning or blocking should be used.
Method 1A-14	Required as applicable	Required when preservative is used	Required (See Notes 6, 7 and 9)	Required	See Notes 6 and 12	See Notes 11 and 12	Markings applied on barrier and outer container.	1. Minimum air void. 2. Cushioning or blocking as required.
Method 1A-15	Required as applicable	Required when preservative is used	Required (See Notes 6, 7 and 10)	Required	See Notes 6 and 12	See Notes 11 and 12	Markings applied on barrier and on outer wrap when used.	1. Minimum air void. 2. Cushioning or blocking as required.
Method 1A-16	Required as applicable	Required when preservative is used	Required (See Notes 6, 7 and 9)	Required	See Notes 6 and 12	See Notes 11 and 12	Markings applied on barrier and outer container.	1. Minimum air void. 2. Cushioning or blocking as required.
Method 1B-1	Required as applicable	.....	.....	.....	See Notes 6 and 10	See Note 11	Markings applied on barrier and on overwrap or container when used.	1. Satisfactory thickness of coating 0.05 in.; small part 0.025 inch minimum.
Method 1B-2	Required as applicable	.....	.....	.....	See Notes 6 and 10	See Note 11	Markings applied on barrier and on overwrap or container when used.	2. Cords for dipping shall be sealed undirected. 3. Coating shall be uniform, homogeneous and shall not stick to item on removal.
Method 1C-1	Required as applicable	Required when preservative is used	Required	Required	.....	See Notes 11 and 12	Marking applied on bag and on container when used.	1. Appropriate size bag. 2. Minimum air void. 3. Cushioning as required.
Method 1C-2	Required as applicable	Required when preservative is used	Required	Required	.....	See Notes 11 and 12	Markings applied on barrier and outer container when used.	1. Minimum void. 2. Cushioning or blocking as required.

TABLE III. *Schedule of Acceptance Tests and Visual Inspection Aids*—Continued

Method IC-3	Required as applicable	Required when preservative is used	Required	Required	.....	See Notes 11 and 12	Marking applied on bag and on container when used.	1. Appropriate size bag. 2. Minimum air void. 3. Cushioning as required.
Method IC-4	Required as applicable	Required when preservative is used	Required (See Notes 3 and 8)	.....	.....	See Notes 11 and 12	Markings applied on container.	1. Minimum air void. 2. If protection other than basic wrap is required, cushioning or blocking should be used.
Method IC-7	Required as applicable	Required when preservative is used	Required	.....	.....	See Notes 11 and 12	Markings applied on blister package.	1. Minimum air void. 2. Item immobilized within pack. 3. Plastic evenly distributed.
Method IC-8	Required as applicable	Required when preservative is used	Required	.....	.....	See Notes 11 and 12	Markings applied on skin package.	1. Minimum air void. 2. Item immobilized within pack. 3. Plastic evenly distributed.
Method IIa	Required as applicable	Required when preservative is used	Required (See Notes 6, 7 and 9)	Required	See Notes 5 and 12	See Notes 11 and 12	Markings applied on barrier and outer container.	1. Minimum air void.
Method IIb	Required as applicable	Required when preservative is used	Required (See Notes 6, 7 and 9)	Required	See Notes 5 and 12	See Notes 11 and 12	Markings applied on barrier and outer container.	2. Desiccant — proper amount used See Formula I and II (3.5.6).
Method IIc	Required as applicable	Required when preservative is used	Required (See Notes 6 and 7)	Required	See Notes 5 and 12	See Notes 11 and 12	Marking applied on bag and on container when used.	3. Humidity indicator window when required.
Method IId	Required as applicable	Required when preservative is used	Required (See Note 8)	.....	See Notes 5 and 12	See Notes 11 and 12	Markings applied directly on metal container.	4. With flexible barrier, sufficient material provided at closure edge.
Method IIe	Required as applicable	Required when preservative is used	Required (See Notes 6, 7 and 10)	Required	See Notes 5 and 12	See Notes 11 and 12	Markings applied on barrier and outer wrap, when used.	5. Cushioning and blocking as required.
Method IIf	Required as applicable	Required when preservative is used	Required (See Note 8)	.....	See Notes 5 and 12	See Notes 11 and 12	Markings applied on container.	
Method III	Required as applicable	.....	.....	.....	.....	See Note 11	Markings on wrap and container when used.	1. Dunnage and wrapping of container, as applicable, to prevent contamination and physical damage in storage. (See 3.5.7).

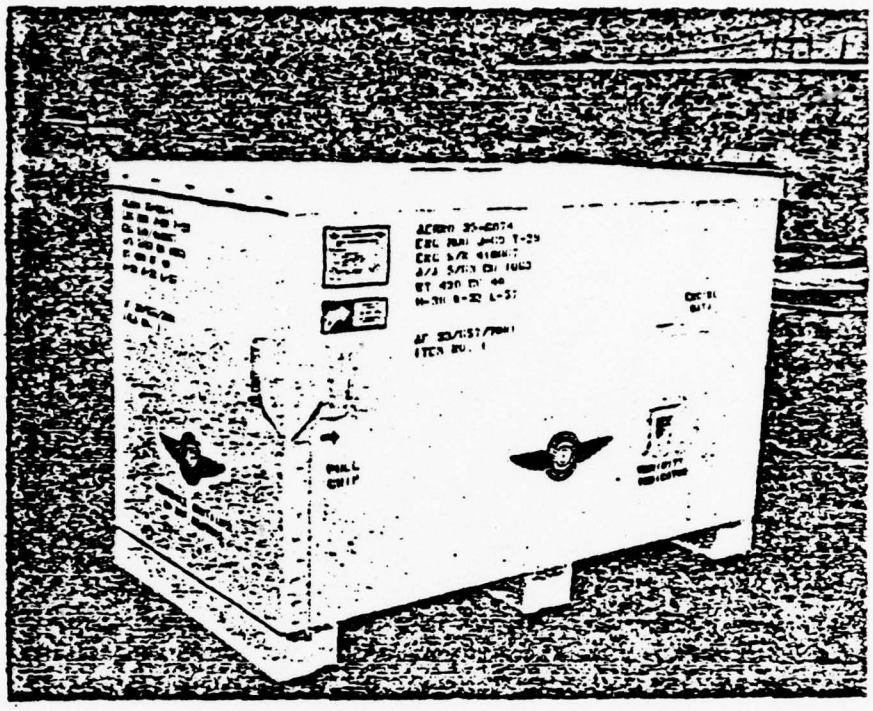
NOTES:

1. At the option of the contractor, alternative leakage tests indicated for some methods in the table may be used in lieu of the vacuum chamber test.
2. When a container for a unit or multiple unit package is used also as an exterior shipping container, the marking applicable to shipping containers as specified in MIL-STD-129 shall be used in lieu of package markings. Identification is not required on wraps placed in snug containers where identification is on the container.
3. The submersion test (4.4.3.4) may be used in lieu of the vacuum chamber test (4.4.3.2) for rigid containers sealed with tape.
4. Materials for preservation and packaging shall be as required for the specific method and as specified in the contract or order.
5. The Cyclic Exposure Test (4.4.5) shall be required only when specified in the contract or order (see 6.2).
6. Vacuum Retention Test (4.4.3.3) may be used in lieu of the Vacuum Chamber Test (4.4.3.2).
7. When specified items by the procuring agency (see 6.2), the Vacuum Retention Test (4.4.3.3) shall be used on specified items in lieu of the Vacuum Chamber Test (4.4.3.2).
8. Pneumatic Pressure Test (4.4.3.5) may be used in lieu of the Vacuum Chamber Test (4.4.3.2). MIL-C-3958 cans may be tested by the Submersion Test (4.4.3.4) in lieu of the Vacuum Chamber Test (4.4.3.2).
9. Remove outer container prior to testing.
10. Outer wrap, when used, shall be removed prior to testing.
11. The Rough Handling Test (4.4.6) shall be required only when specified in the contract or order (see 6.2).
12. Subsequent to the Cyclic Exposure Test and the Rough Handling Test samples shall be examined, where applicable, for retention of the preservative compound (see 4.4.7).

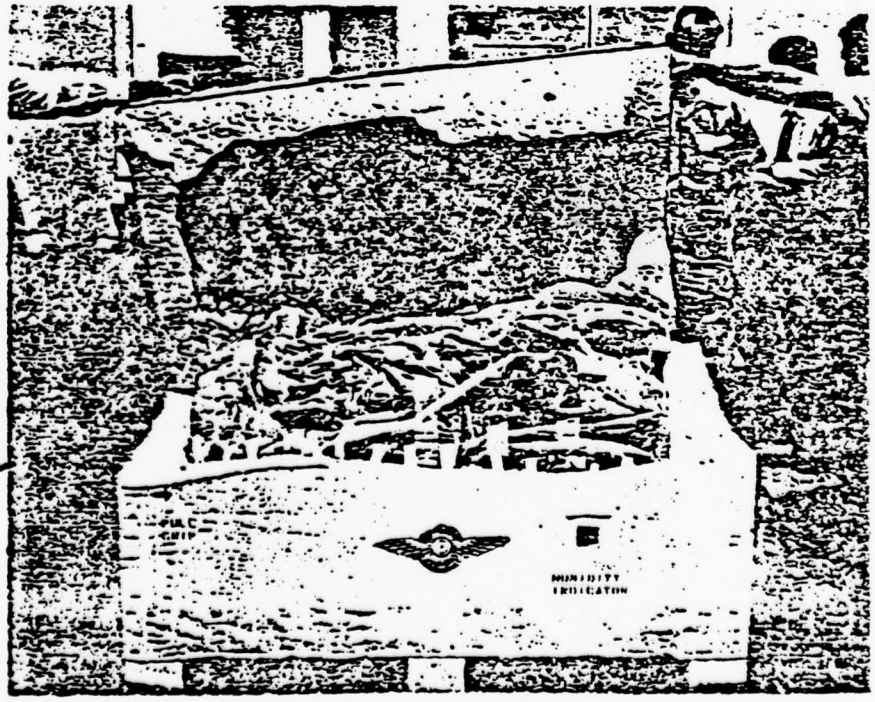
APPC4

APPENDIX D

SAMPLES OF NEW PACKAGING TECHNIQUES MILITARY AND COMMERCIAL

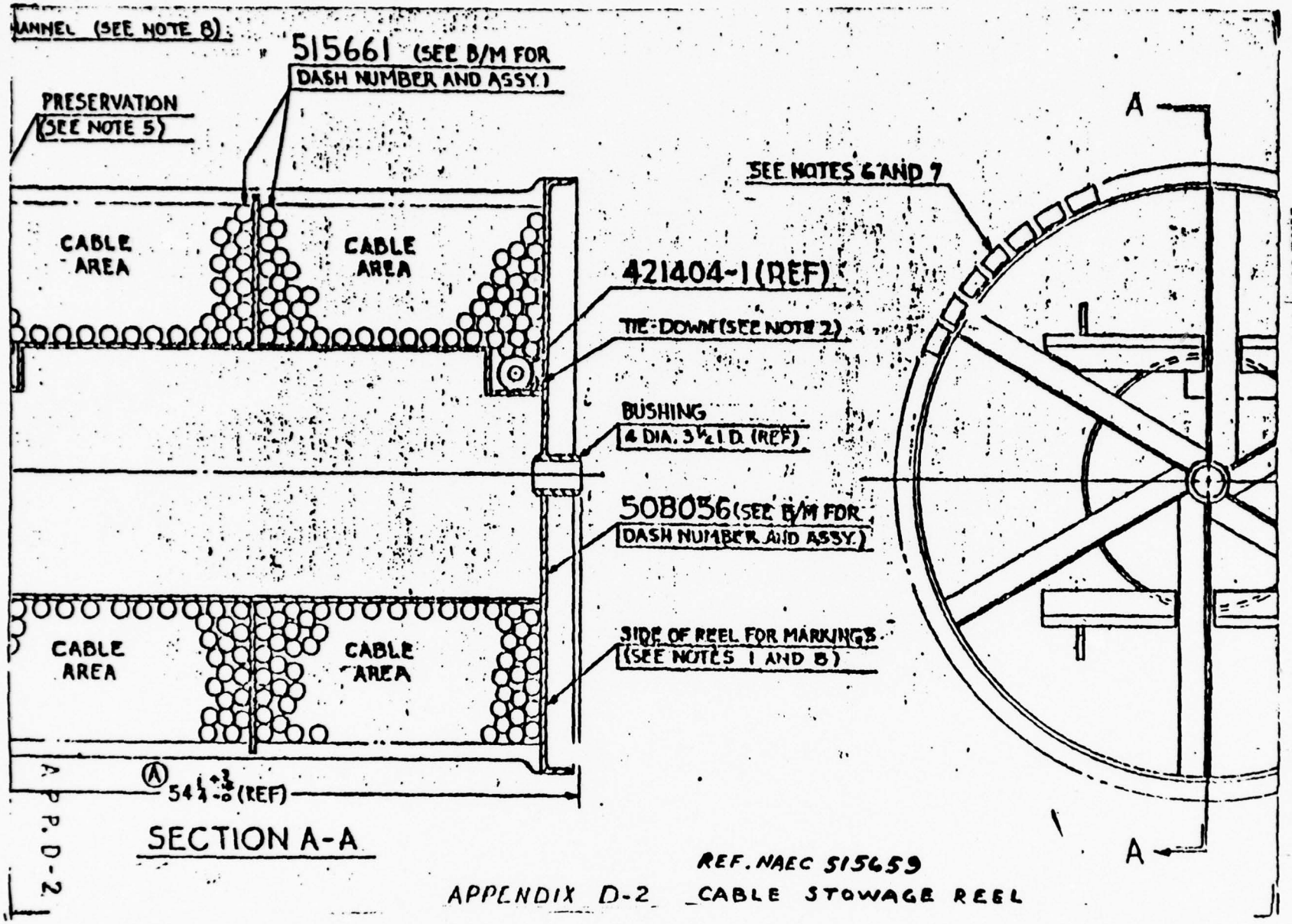


Compressor Packaging Completed



Shipping Box Cut Open to Show Foam in Place

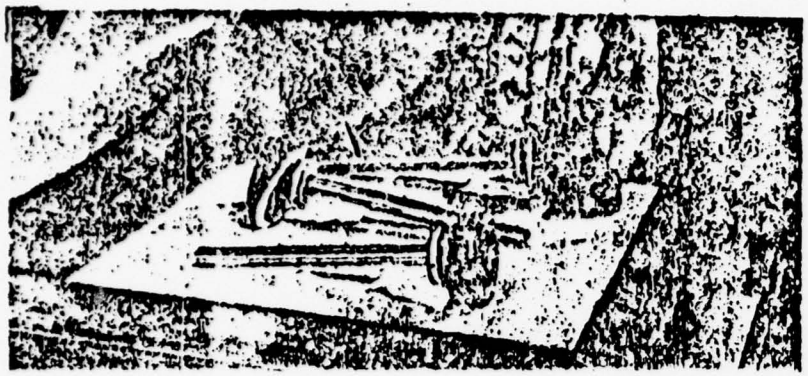
PACKAGING OF GAS TURBINE COMPRESSORS (Sheet 3 of 3)



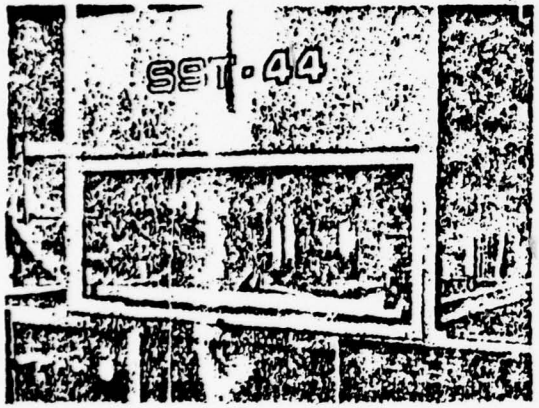
REF. NAEC 515659

APPENDIX D-2 CABLE STOWAGE REEL

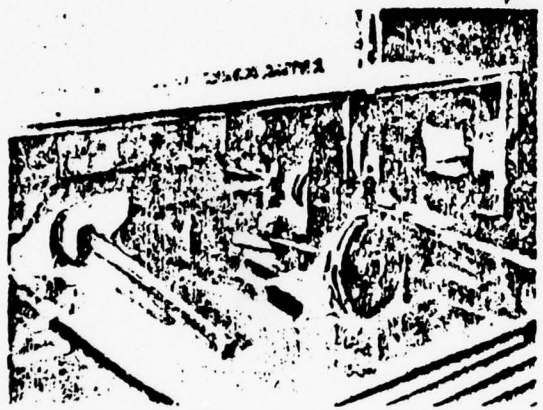
skin packs to speed parts delivery



Whirlpool's efficient packaging sequence begins with an SST-44 skin packager. One operator loads two or three parts, along with needed hardware, onto corrugated fibreboard pads on the infeed table of the machine.



A front view of the Trans-Seal machine shows a pad load of basket drives being sealed in the forming unit. Parts are sealed to the pads with Stone Super-Tough Industrial film in either 6-mil or 10-mil gauges, depending on product weight and size.



The SST-44 automatically moves multi-part loaded pads through the slitter-guillotine for separation into individual skin packs. With these parts the guillotine is not needed for lateral separation.

Separated parts are moved from the output con of the SST-44 to the input conveyor of the S Rap-A-Mat container forming machine. Her operator places a flat container blank on machine's infeed platform, folds the skinned pa prescored lines and places the part on the par formed blank.

wins with recyclable pack

INDUSTRIAL packaging can be both effective in operation and safe to the environment. And Ford Motor Co.'s General Parts Div. has proven that point with its new, totally recyclable packaging system for shipping carburetors.

The new transport package, called the carburetor shrink pack, is used for shipping finished carburetors from Ford's Rawsonville, Mich., plant to six different Ford engine plants in the U.S. and Canada. Each carburetor shrink pack consists of a pallet (60 lb), 12 intermediate trays (15 lb each), a plastic cover (30 lb) and heat shrinkable film overwrap (2.9 lb).

The carburetor shrink pack replaces a seven-part corrugated pallet tray pack which held 60 carburetors and was stacked two-high for shipping. With the new system each pallet holds 112 carburetors and can be stacked in columns of four. Minimum life expectancy for the new packaging is 40 round trips or four years. All materials used are returned for recycling rather than being disposed of as normal solid waste.

Dunnage trays and covers for the carburetor shrink pack are injection molded of Marlex (Phillips Petroleum Co.) HDPE structural foam by Robinson Industries. Shrink film overwraps are supplied by Cadillac Plastics.

The carburetor shrink pack system recently won three awards in the Society of Packaging and Handling Engineers' national competition held in Tulsa, Okla. It was judged Best of Show, Best of Plastics and tops in the Quality of Environment category.

Cadillac Plastics Co., Dayco Div., 15111 Second Ave., Detroit, Mich 48203. *Circle No.* 113.

Phillips Petroleum Co., Chemicals Dept., Plastics Div., Bartlesville, Okla. 74003. *Circle No.* 114.

Robinson Industries, Coleman Mich 48618. *Circle No.* 115.

50,000 bubbles per cu. in. protect delicate parts

Pouches of Microfoam Sheeting package printed circuit cards and other delicate electronic items. Control Data packaging engineer Gene Richgels examines continuous length of the pouches that are made on an impulse heat sealer.

Pouch with printed circuit board is on left. On right a CDC delicate part is wrapped in Microfoam Sheeting. After spare parts are wrapped, a rubber stamped code is applied to the Microfoam.

DELICATE ELECTRONIC PARTS for the computer industry, as might be expected, require protective cushioning materials that are lightweight, damage resistant, and "clean"—i.e. non-dusting.

For Control Data Corp., a leading supplier to the computer industry, rigid packaging standards for shipment of its delicate parts are being met using Du Pont's new cushioning material, Microfoam Sheeting. It is being used to make protective pouches for printed circuit cards and as general purpose wrap for other fragile parts.

Secret to the polypropylene foam product introduced last year are the 50,000 air-filled bubbles per cubic inch that assure no appreciable loss of cushioning protection if one or more of them are broken by sharp or heavy impacts.

Abrasion damage to finishes and surfaces are reduced because of the material's high coefficient of friction. As packages are jostled during shipment, for example, the Microfoam clings to the surface of the wrapped part. In addition, Microfoam contains no solvent plasticizers or lubricants to offset surface finishes.

Control Data obtains its Microfoam in 8, 12, and 16 in. widths from a local distributor, which offers, as do all Du Pont-authorized distributors, slicing and warehousing facilities for supplying sheet, roll and perforated material in various thicknesses and custom-specified widths.

Du Pont Co., Wilmington, Del. 19898.

Circle 122 on Reader Rank Form

APPENDIX E

NAEC FIELD REPORTS-SAMPLE FORMS

2ND-NAEC-2455(REV. 2-68)
PLATE NO. 11968

Arresting Gear Field Technical Report
NAEC 2104 (Rev 8/69)

REPORT NO.____
DATE_____

CARRIER AND FIELD
SERVICE UNIT

From: _____ NAEC Field Technician_____
To: Fleet Operations Service Officer, NAEC
Ship or Activity Visited:_____
Location:_____
Date Arrived:_____ Date Departed:_____
Purpose:_____
Personnel Contacted: A/G Officer_____ A/G CPO_____
_____
Arresting Gear Type:_____

ITEM	COMMENT
1. MAIN ENGINE CYLINDER AND RAM	
2. CONSTANT RUNOUT VALVE AND DRIVE SYSTEM	
3. RETRACT VALVE AND CONTROLS	
4. ACCUMULATOR/AIR FLASK ASSEMBLY	
5. COOLER ASSEMBLY	
6. DRIVE SYSTEM A. Cables B. Poured Terminals C. Fairleads and Guides	
7. SHEAVES AND SHEAVE GUARDS	
8. ELECTRICAL SYSTEM	
9. BARRICADE A. Stanchions B. Power Package C. Controls	
10. WIRE SUPPORTS	
11. SHEAVE DAMPERS	
12. ANCHOR DAMPERS	
13. CHANGES ACCOMPLISHED	
14. MISCELLANEOUS	APP. E-1

Steam Catapult Field Technical Report
End-NAEC 13810/5 (Rev 3-73)

REPORT NO.
DATE

CARRIER AND FIELD
SERVICE UNIT

From: NAEC Field Technician
To: Fleet Technical Service Officer, NAEC
Ship Visited:
Location:
Date Arrived: Date Departed:
Purpose:
Personnel Contacted; Air Officer Catapult Offi
Catapult Maintenance Officer Other
Steam Catapult Model/s:

ITEM	COMMENT
1. POWER CYLINDERS/SEALING STRIP/SHUTTLE AND PISTON ASSEMBLY/LUBRICATION SYSTEM	
2. WATER BRAKE COMPONENTS	
3. DECK TENSIONING SYSTEM/NOSE GEAR LAUNCH	
4. ELECTRICAL SYSTEM	
5. CONSOLE COMPONENTS	
6. RETRACTION ENGINE A. Cables & Sheaves B. Equalizers C. Buffers D. Grab E. Hydraulic Control System	
7. PUMPS/VICKERS AND LUBE PUMPS	
8. LAUNCHING/EXHAUST/CONTROL VALVES	
9. GRAVITY TANK/COOLER/CONTROLS	
10. DECK ACCESSORIES INCL, BRIDLE ARRESTER	
11. STEAM SUPPLY EXHAUST AND PRE-HEAT PROBLEMS	
NAVSHIPS INTERFACE AREAS	
12. STEAM SUPPLY/EXHAUST/STEAM SMOTHERING	
13. FLOW CONTROL VALVE/RECEIVERS	
14. CORROSION & CONTROL ~~DATA~~ /PACKING PROBLEMS	APP. E-2

Report #157-72
USS RANGER/MK7

FIELD TECHNICAL REPORT
NAVAL AIR ENGINEERING CENTER
PHILADELPHIA, PA. 19112

26 June 1972

From: NAEC Field Technician, COMNAVAIRPAC
To: Fleet Technical Service Officer, NAEC

Subj: Preservation and Packaging Methods of Mk 7 Barricade Webbing Assembli

Encl: (1) Photos: (3 views) of barricade "as received"
(2) REI No. 69-6119
(3) REI No. 69-6162

DISCUSSION AND BACKGROUND

Recently the V-2 Division of USS RANGER (CVA 61) procured a barricade fr the supply system through normal supply channels. The physical appearance o outside of the box seemed normal and no damage was evident. However when th box was opened it was readily apparent that the preservation methods used we are wholly inadequate to protect the barricade. This is very clearly depict in enclosure (1) views one through three. Needless to say, the webbing was 'soaked' and reeked of mildew.

This is not the first reported discrepancy dealing with webbing assembli enclosures (2) and (3) call attention to similar problems although not quite as severe.

Informal conversation with shipyard packaging and preservation personnel indicated that this problem could be solved by utilizing the methods conform to MIL-P-116E Section 1A-8 (water/vapor proof bag, sealed). The bag itself, which conforms to MIL-B-131E Class 1 and 2, can be made to any size or shape depending on the need of the user. It is heat sealed to preclude entrance o water or vapor. An additional suggestion would be the use of sufficient bag of desiccant to be packaged with the webbing to remove any ambient moisture in the barricade prior to packaging.

RECOMMENDATIONS

Recommend NAEC and BRASO Quality Assurance resolve this problem by purgi the system of contaminated webbing assemblies and ensuring that adequate packaging and preservation methods are utilized to ensure the quality of this seldom used but vital piece of emergency equipment.

/s/ Richard M. Schuman
RICHARD M. SCHUMAN

DISTRIBUTION:
COMNAVAIRSYSCOM (AIR 537)
COMNAVSHIPSYSCOM (Code 422V)
CO NAVAIRTESTFAC Lakehurst
CO USS RANGER (CVA 61)
CO NATTC Lakehurst (Attn. TRBO)
NNSB&DDCO (Code 271)
Distribution List No. 2

APP. E-3

NAVAL AIR ENGINEERING CENTER FIELD QUALITY & ANALYSIS BRANCH CODE QA-4

FAST ACTION DISCREPANCY REPORT (FADR)

NOTE: This is a quick and informal means of reporting defective material. We need the contract number and contractor's name to take corrective action. The more info we get, the faster we can take action.

TO: FIELD QUALITY & ANALYSIS BRANCH, CODE QA-4

FROM: SHIP:_____ DATE:_____

The below material has been found unsatisfactory as noted:

P/N_____ FSN_____ CONTRACT NO._____

NAME_____ CONTRACTOR_____

QUANTITY_____ New Used ORIGIN:_____

Describe deficiencies:_____

NAEC 13800/4 Rev. 10-72

_____ DATE

_____ INVESTIGATOR

NAEC 13820/3A Rev. 12-67

_____
(date)

Received your FADR card of _____ concerning _____

_____

Action initiated as follows: _____

_____

_____

_____

_____

_____

_____

_____ _____

NAEC INVESTIGATOR Head, Field Quality & Analysis Br. ~~(mr-55)~~

APP. E-5

NAEC-ENG-7818
PAGE E-6

AND-NAEC-2455(REV. 2-68)
PLATE NO. 11902

AND NAEC 4855/4BA(6-69) REQUEST FOR SALVAGE ACTION SHEET 1 OF 1

CONTRACTOR/ACTIV. TY	NOMENCLATURE	DATE	REQUISITION
NAEC OA-4	FSN 1710-636-1326	4-11-72	72-605

DWG./PART NUMBER	MODEL	REV.	CONTRACT/SCHEDULE	SER. NO.	LOT SIZE	QTY. INSP	QTY.
501549-7	MK	4	UNKNOWN			10 1	11

I. DESCRIPTION OF NON-CONFORMANCE

SEVERE RUST THROUGHOUT - ALL SURFACES.

2. A "HOLD! DO NOT ISSUE" TAG DATED 4-11- HAS BEEN ATTACHED TO THE MATERIAL.

3. THE MATERIAL IS LOCATED IN BLDG #46 AT REM, NSC.

4. UNIT PRICE: $ 416.00

5. CONTRACT WARRANTY IS NOT IN EFFECT.

6. RECOMMEND - SCRAP

II. REDUCTION IN PRICE (SPECIFY)

III. If salvage action is authorized, contractor permanently mark and supply reproductions of for the part(s) involved.

SIGNATURE OF COMPANY OFFICIAL

IV. DCASR/SHOP SUPERINTENDENT REVIEW

NOTE: ORIGINALS MUST BE SUBMITTED FOR PROCESSING AND DISTRIB

SIGNATURE OF DCASR/SHOP SUPERINTENDENT

V. NAEC DISPOSITION INSTRUCTIONS

☐ APPROVED ☐ DISAPPROVED

ENGRG DEPT

SCRAP AS RECOMMENDED.

4/20/72 CEB(1)E

NAEC COMMENT PREPARED BY	NAEC COMMENT APPROVED BY	DATE	QUALITY ASSURA
T. Kwok 4/21/72			

VI. CONTRACTING OFFICE (NAEC)

NAVAIR-NAEC-2455(REV. 2-68)
PLATE NO. 11902

REQUEST FOR ENGINEERING INFORMATION
NAVAIR-NAEC-3900/7 (REV. 8-68)

CONTRACTOR OR ACTIVITY		DEPT OR DIVISION	CONTRACT OR SCHEDULE NUMBER
NAEC		Field Quality & Analysis Br., NF-33	
MODEL	BUG/PART NO AFFECTED	TITLE	
E2A	614148-1	E2A Barricade	
SUPERVISOR	INSPECTOR	REASON (Reference)	
E.VanRoken	C.R. Dewitt	FADR Report	

QUALITY ASSURANCE PROGRAM

1. The following information was received via Fast Action Discrepancy Re (FADR) from the USS AMERICA CVA-66.

a. "Webbing assembly was water soaked. No damage was noted on box water-proof package prior to opending."

2. Engineering comments are requested for transmittal to Fleet Personnel

/s/ C. R. Dewitt ABE1 USN
Ext. 3389/3722

NAEC ENGINEERING COMMENT

Webbing assembly "water-soaking" is normally due to the ambient moisture at by the webbing in the time between initial procurement and final uncrating. not harmful to the webbing beyond a 5 to 10% loss (maximum) of strength. T strength, however, is essentially recuperated once the barricade is "dry" a relatively speaking, and not soaked to the touch.

A method of removing or preventing this moisture retention, prior to packin be investigated.

APP. E-7

Encl. (5)

APPENDIX F

NAEC FIELD REPORTS OF DEFECTIVE PARTS AND BRASO FORM 17 CARDS FOR PACKAGING INSTRUCTIONS FOR THESE PARTS.

F-1 Barricade (P/N 614148-1) Report and History Card

F-2 Tension Bars/Release elements (MIL-T-23426)

F-3 Lever (P/N 501549-7)

F-4 Union Nuts (P/N A414240-1)

F-5 Inner Race (P/N C87780-47)

F-6 Sheave Sub-Ass'y

F-7 Spacer (P/N 53-40112-2)

F-8 Cable (P/N 29-40707-775)

F-9 Sleeve (P/N 408402-1)

F-10 Cable (P/N A-92791-27-1750; -13-600)

F-11 Track Section (P/N 408084-2; -3)

F-12 Socket Eye End (P/N 400790-1)

F-13 Inner Spacer (P/N 71-40212-2)

F-14 Clevis Pin (P/N 317434-1)

F-15 Piston Rod (P/N 504130)

F-16 Cap Assembly (P/N 504047-1)

F-17 Strap Assembly (P/N 504821-1; -3)

F-18 Valve (P/N 509979-1)

F-19 Piston Assembly (P/N 613101-7)

F-20 Piston Assembly (P/N 613101-13)

F-21 Sealing Strip (P/N 613380-2)

SEE MPR 1290 FOR NEW PACKAGING METHOD

FIELD TECHNICAL REPORT
NAVAL AIR ENGINEERING CENTER
PHILADELPHIA, PA. 19112

26 June 1972

From: NAEC Field Technician, COMNAVAIRPAC
To: Fleet Technical Service Officer, NAEC

Subj: Preservation and Packaging Methods of Mk 7 Barricade Webbing Assemblies

Encl: (1) Photos: (3 views) of barricade "as received"
(2) REI No. 69-6119
(3) REI No. 69-6162

DISCUSSION AND BACKGROUND

Recently the V-2 Division of USS RANGER (CVA 61) procured a barricade from the supply system through normal supply channels. The physical appearance of outside of the box seemed normal and no damage was evident. However when the box was opened it was readily apparent that the preservation methods used were are wholly inadequate to protect the barricade. This is very clearly depicted in enclosure (1) views one through three. Needless to say, the webbing was 'soaked' and reeked of mildew.

This is not the first reported discrepancy dealing with webbing assemblies enclosures (2) and (3) call attention to similar problems although not quite as severe.

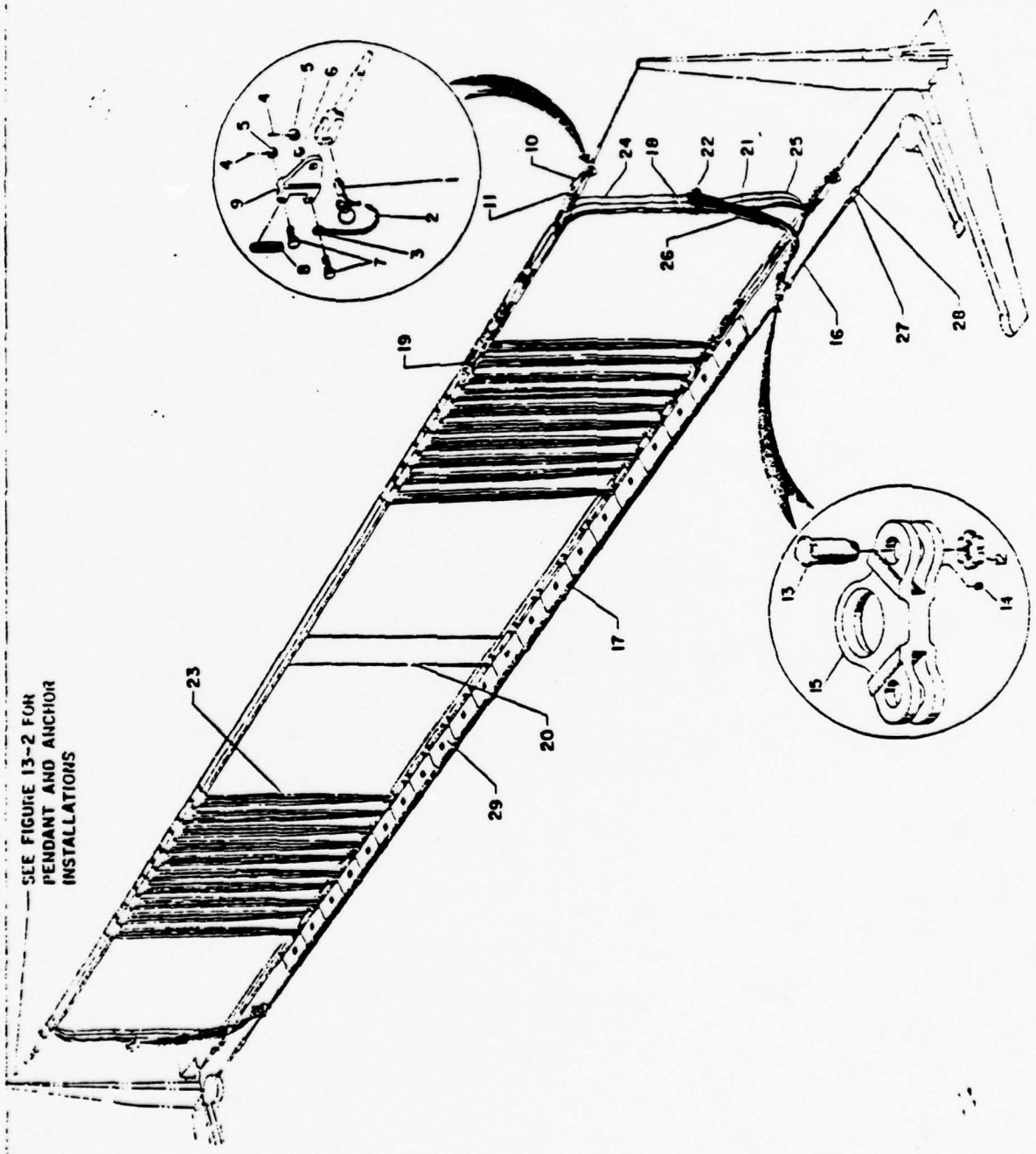
Informal conversation with shipyard packaging and preservation personnel indicated that this problem could be solved by utilizing the methods conforming to MIL-P-116E Section 1A-8 (water/vapor proof bag, sealed). The bag itself, which conforms to MIL-B-131E Class 1 and 2, can be made to any size or shape depending on the need of the user. It is heat sealed to preclude entrance of water or vapor. An additional suggestion would be the use of sufficient bags of desiccant to be packaged with the webbing to remove any ambient moisture in the barricade prior to packaging.

RECOMMENDATIONS

Recommend NAEC and BRASO Quality Assurance resolve this problem by purging the system of contaminated webbing assemblies and ensuring that adequate packaging and preservation methods are utilized to ensure the quality of this seldom used but vital piece of emergency equipment.

/s/ Richard M. Schuman
RICHARD M. SCHUMAN

DISTRIBUTION:
COMNAVAIRSYSCOM (AIR 537)
COMNAVSHIPSYSCOM (Code 4Z2V)
CO NAVAIRTESTFAC Lakehurst
CO USS RANGER (CVA 61)
[illegible]
CO NATTC Lakehurst (Attn. TRBO)
NNSB&DDCO (Code 271)
Distribution List No. 2



APP. F-2

ENCLOSURE 1

FIELD TECHNICAL REPORT
NAVAL AIR ENGINEERING CENTER
PHILADELPHIA, PA 19112

Report # 148-7
19 June 1972

From: NAEC Field Technician, COMFAIRMED
To: Fleet Technical Services Officer, NAEC

Subj: Launching Accessories (Tension Bars); Issue control of

Ref: (a) ASO ltr ser SCW4-103:MP:ftc Serial 10290 of 15 May 1972

Encl: (1) Copy of DD Form 1348-1, DOD Single Line Item Release/Receipt Docum
(2) Picture of packing container of F-8 Tension Bars as initially open
(3) Close-up view of enclosure (2)
(4) & (5) Close-up view of rejected Tension Bars in subject shipment

1. Reference (a) is a recent letter governing the issue control of Tension Ba
It specifies, among other things, that:

(a) All Tension Bars are to be issued in complete lots.
(b) No lots are to be split.
(c) Current packaging and marking instructions for the contractor.

2. It is noted that there is no specific prohibition governing the repackagin
and or combining of whole lot quantities into larger shipments. It is further
noted that no intermediate quality control inspection is cited in the event it
is necessary to repackage/combine lots into larger consignments.

3. Enclosure (1), although predating reference (a) by some considerable time,
is an indicator of the need for additional and more specific instructions in thi
area. This shipment, from NAS Jacksonville, Florida was in response to a requ
tion for 200 F-8 type Tension Bars FSN IR 1720-866-7019 for USS FRANKLIN D. RO
(CVA 42). The shipment, opened in the writers presence, was as shown by enclo
(2) and (3). Detailed inspection of the bars resulted in approximately 30% re
for excessive corrosion and pitting as shown by enclosures (4) and (5).

4. It is considered that the condition of these Tension Bars was the result o
several factors:

(a) Age
(b) One or more instances of repackaging
(c) Less than ideal storage environment

5. It is recommended that NAEC institute proceeding to insure:

(a) ASO reissue reference (a) as a Notice or Instruction to insure wide a
better controlled distribution.
(b) Amend the contents of reference (a) when rewritten as an Instruction
Notice to include:

(1) Detailed packaging/repackaging requirements for all intermediate
activities.

ENCLOSURE 1

REPORT # 148-72
19 June 1972

Subj: Launching Accessories (Tension Bars); Issue control of

(2) Stowage requirements.
(3) Periodic or preissue quality inspection of the contents and package at issue control points.

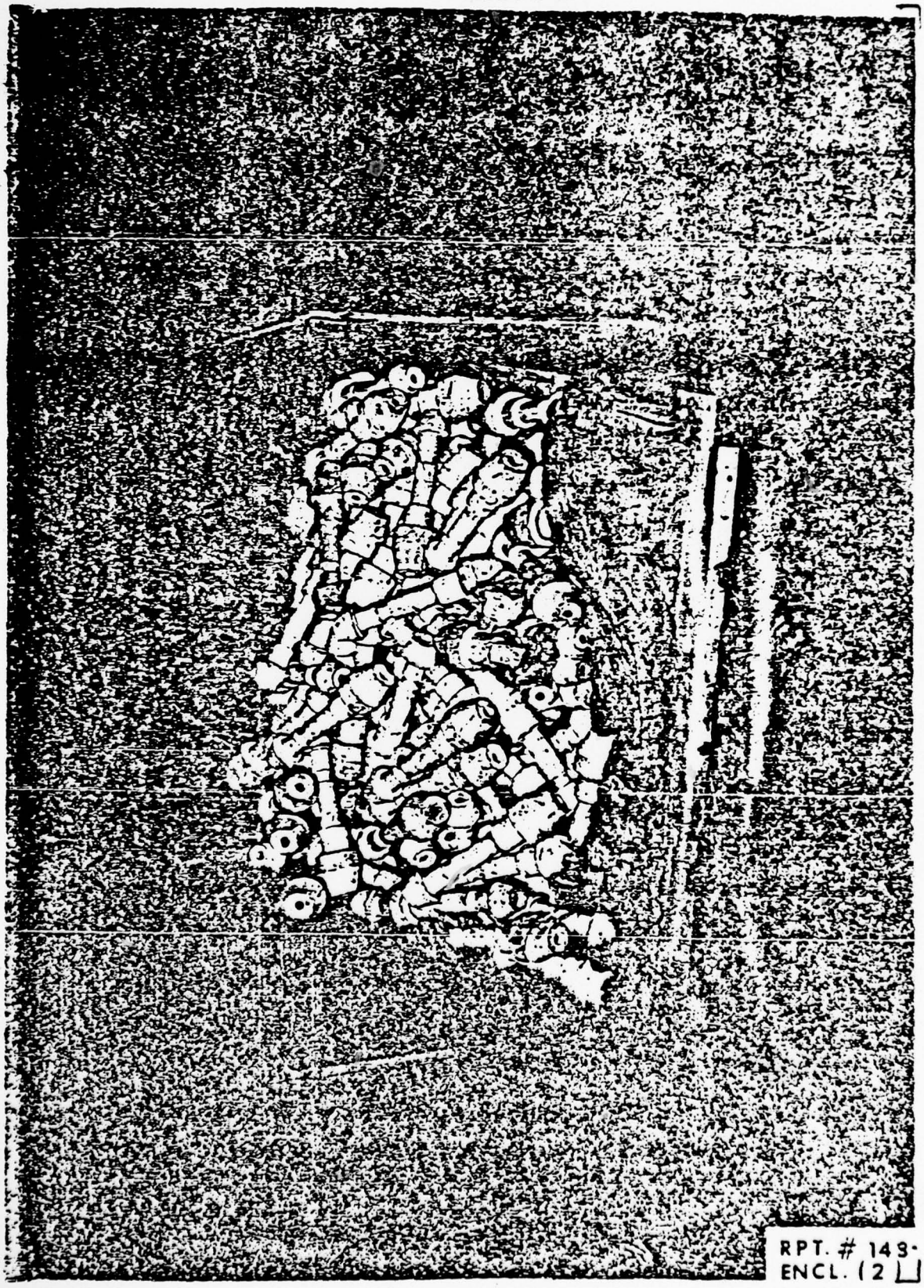
6. It should be noted that packaging and issue control requirements are equ. important for other launching accessories (such as bridles and pendants) as as Tension Bars.

/s/ C. C. Roy
C. C. ROY

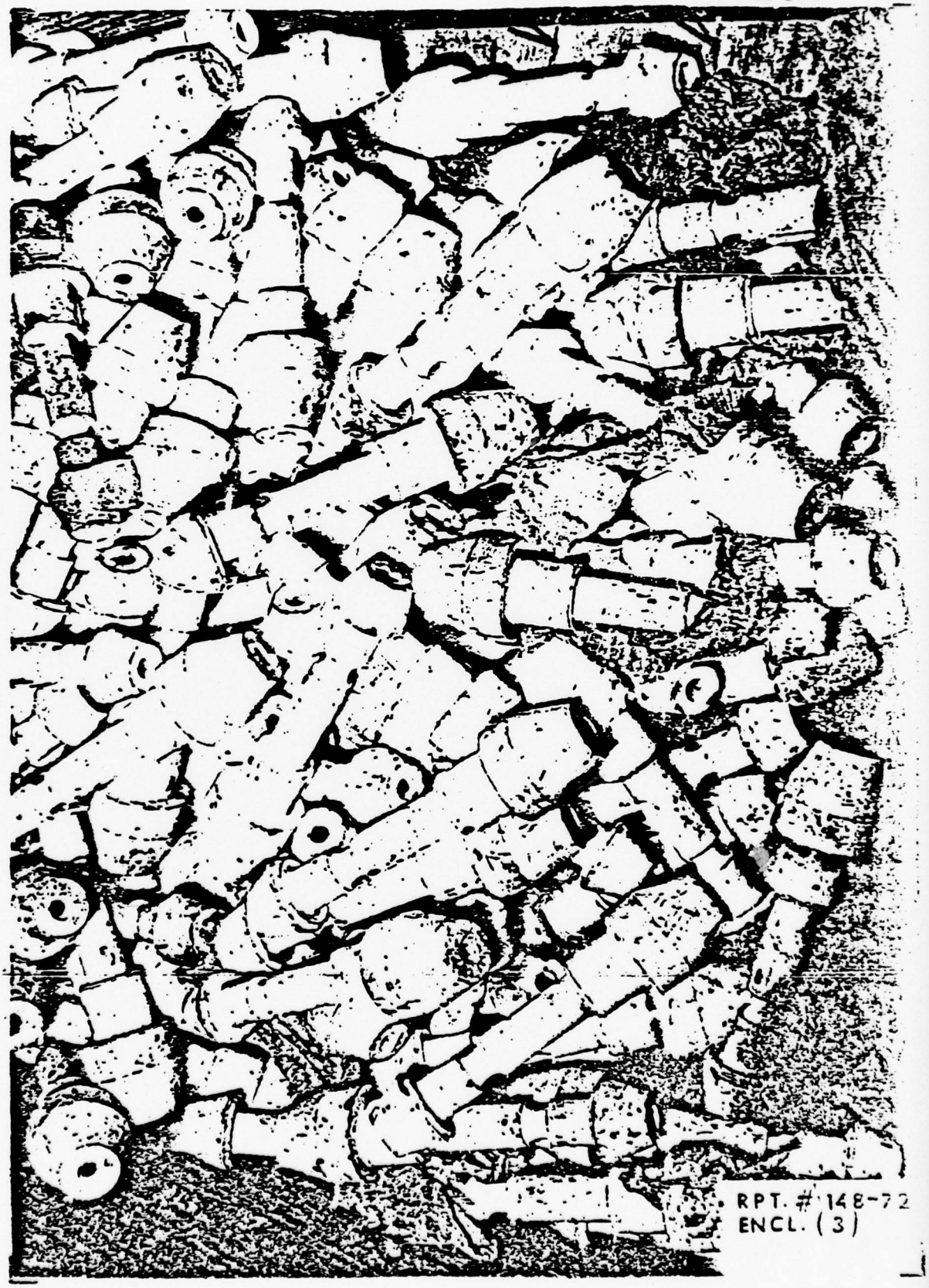
DISTRIBUTION:
NAVAIRSYSCOM (CODE AIR-537)
NAVSHIPSYSCOM (CODE 422V)
USS FRANKLIN D. ROOSEVELT (CVA 42)
NATC PAX RIVER FLIGHT TEST DIV.
CO, NATF (SI) LAKEHURST
COMFAIRWESTPAC (CODE 712)
NEWPORT NEWS SHIPBUILDING & DRY DOCK COMPANY (CODE 271)
NATTC LAKEHURST (ATTN: TRBO)
DISTRIBUTION LIST #1

REI issued #72-5052

APP. F-2



RPT. # 143
ENCL. (2)



RPT. # 148-72
ENCL. (3)

FROM: N.A.E.C., LAUNCHER SHIPBOARD DIVISION (NOT ISSUED)

TO: ALL CONCERNED (ESSD, ASO, BRASO, SPEC. COGNIZANT DESK, WASH. D. C., ETC.)

SUBJ: Military Specification MIL-T-23426A(AS) dated 13 Nov. 1967; Amendment 1 dated 19 Sept. 1972, Proposed updating.

ENCL. (1) N.A.E.C. Field Report 148-72 dated 19 June 1972, Tension bars, Issu control

(2) Excerpt from MIL-T-23426A(AS) paragraph 5. Preparation For Delive

(3) Excerpt from MIL-STD-794, 8 Dec 1972 paragraph 30.1.2. Critical group items -

(4) A.S.O. Packaging instructions #12152 (dated 4 Oct 1968)

(5) Fed. Std. No. 102 dated 29 Jan. 1963)

(6) MIL-T-23426A(AS) Amendment 1 dated 19 Sept 1972

(7) MIL-T-23426A(AS) Proposed Amendment 2

Reference (a) Contract N00156-72-A-0009 Task Order #0058 Preservation and Packaging of Catapult Components and Corrosion Control of Pneumatic Systems In Marine Environment.

As part of a study program prompted by reference (a) an investigation into the ca for the situation revealed in enclosure (1) was pursued.

It was determined that the original packaging procedure, enclosure (2), could inadvertently allow shipment of the subject tension bars to the ultimate user (catapult personnel) at a level C protection rather than a level A and would not adequately prote the bars from corrosion.

A subsequent request for improved packaging level of the tension bars (very critic items, enclosure (3), requiring rigid inspection and testing upon fabrication) was effect by the release of enclosure (4), requiring level A, enclosure (5), packaging only.

A further release of amendment 1, enclosure (6), reintroduces level C protection to be used in shipment from supply source to shipping point. This current procedure now allows for the possibility of tension bars to inadvertently being shipped to user (catapult personnel) at the level C protection.

Therefore, it is the intent of enclosure (7) to eliminate any possible misunderstanding and package the tension bars at level A only from initial supply source to ultimate user in catapult area.

Preservation and Packaging procedures shall be accomplished in accordance with Military Specification MIL-P-1 Both the hollow (Type I) and solid (Type II) tension bars shall be cleaned in accordance with process C-1. Th hollow portion of the Type I bars shall be coated with preservative compound type P-1 or P-19 as specified fo Method I; no preservative compound shall be permitted on the painted surface of the Type I tension bar. Type II tension bar does not require a preservative compound. A single lot of tension bars, fabricated from a single lengthof bulk stock (approximately 60 bars) shall be unit packaged Method III of MIL-P-116 within two fiberboard boxes, not exceeding 30 tension bars per container. Fiberboard boxes used shall conform to Federal Specification PPP-B-636, Type CF or SF, Class-Domestic, Grade 275 (as a minimum). When corrugated fiberboard is used, Variety DU is required. The tension bars shall be secured and cushioned within each container by using half notched, criss cross (egg cell type) corrugated fiberboard separators, designed to hold each bar snugly in upright position. A single corrugated fiberboard pad shall be used under and over (top and bottom) of the load to reinforce the container. Corrugated fiberboard pads shall be fabricated of material conforming to PPP-F-320, Class-Domestic. The two unit packages comprising one lot shall be packaged within an intermediate container, conforming to PPP-B-640, Class2, for contents over 100 pounds or a container conforming to PPP-B-636, Class Weather Resistant, Grade 3 (as a minimum) for contents up to 100 pounds.

Packing - The intermediate packs specified above shall be prepared for shipment by palletizing/unitizing on expendable wood pallets capable of bearing loads up to 2400 pounds. The preparation of the palletized loads shall be in accordance with either Military Specification MIL-L-35078 or MIL-STD-147. Palletized loads shall contain complete lots of tension bars only; lots should not be split up on more than one pallet.

Marking - Unit and intermediate containers as well as the palletized load shall be marked in accordance with MIL-STD-129. Additionally the following special markings are required on each unit and intermediate container

(a) TOP OPEN THIS SIDE ONLY
(b) LOT NUMBER AND/OR SERIAL NUMBERS AND QUANTITY OF BARS IN THE LOT
(c) NOTICE - ISSUES SHALL BE MADE IN COMPLETE LOT QUANTITIES ONLY - DO NOT BREAK LOTS!!!!!!

Notice: Co-mingling of bars from more than one lot in the unit packages is absolutely prohibited. When more than sixty bars are fabricated from one lot of steel, necessitating exceeding the 30 bar per container limitation; a waiver may be granted by directing a request to the Aviation Supply Office Code TEP.

ENCLOSURE 4

IT	QTY	DESCRIPTION	DIMENSION	W
9				
8				
7				
6				
5				
4				
3				
2				
1				

DRAWN BY	DATE	AVIATION SUPPLY OFFICE
Jub	11/15/68	TENSION PAR (RELEASE BY

APP. F-2

AND-NAEC-2455(REV. 2-68)

PLATE NO. 11962

[illegible]-919-2140-BA6X	(80020) 506713-1	Tension Bar
272-7532-SX6X	506722-4	"
073-1243-SX6X	506996-1	"
969-5453-SX6X	(26512) 12SCVM10500-5	Element, Release
962-E935-[illegible]-SX6X	506409-1	Tension Bar
966-7019-EF6X	(80020) 413[illegible]-1	"
MS1730-056-9216-SX6X	215-24607-3	"

ENCLOSURE 4

9													
8													
7													
6													
5													
4													
3													
2													
1													
IT	JM	DESCRIPTION	DATE	APPROVED									DIRECTION

DRAWN BY: [illegible] AVIATION [illegible]

APPROVED: [illegible] DATE: 10/65 CODE: 80132 DWG NO. 12152

DIMENSIONS IN INCHES

TENSION BAR, (RELEASE E

ENCLOSURE 6

MIL-T-23426A(AS)
AMENDMENT 1
19 September 1972

MILITARY SPECIFICATION

TENSION BARS, AIRCRAFT, LAUNCHING

This amendment forms a part of Military Specification MIL-T-23426A(AS), 13 November 1967, and has been approved by the Naval Air Systems Command, Department of the Navy.

Page 12

Paragraph 5.1: Delete and substitute:

"5.1 Cleaning and preservation - The hollow portion of the Type I tension bar shall be cleaned in accordance with process C-1 of MIL-P-116 and coated with either Type P-1 or P-19 preservative in accordance with Method I of MIL-P-116. No preservative compound shall be permitted on the painted surface of the Type I tension bars. Type II bars do not require a preservative compound."

Paragraph 5.2.1: Delete and substitute:

"5.2.1 Level A - Tension bars shall be packaged by lot control. A lot of tension bars, machined from a single length of bulk stock (approximately 60 bars), shall be unit packaged Method III of MIL-P-116 using two fiberboard boxes, not exceeding thirty (30) bars per container. Fiberboard boxes shall conform to PPP-B-636, Type CF or SF, Class Domestic Grade 275 (as a minimum). When corrugated fiberboard containers are used, Variety DV is required. Tension bars shall be secured and cushioned within each container by using half slotted, crisscross (egg cell type) corrugated fiberboard separators, designed to hold each bar snugly and in an upright position. A single corrugated fiberboard pad shall be used under and over (top and bottom) of the load to reinforce the container. Corrugated fiberboard pads shall conform to PPP-F-320, Class-Domestic. When smaller quantities of bars comprise a lot, no more than one lot shall be packaged in a unit container and no more than two lots to an intermediate container."

Add the following new paragraph:

"5.2.1.1 Intermediate packaging - Two unit packages with no more than thirty (30) bars in each, unit packaged as specified in 5.2.1, shall be packaged within an intermediate container conforming to PPP-B-640, Class 2 for contents over 100 pounds or a container conforming to PPP-B-636, Class Weather Resistant, Grade V3 (as a minimum) for contents up to 100 pounds.

FSC 1720

MIL-T-23426A(AS)
AMENDMENT 1

ENCLOSURE 6

Page 12

Paragraph 5.2.2: Delete and substitute:

"5.2.2 Level C - Tension bars shall be preserved and packaged for shipment in a manner that will prevent deterioration or physical damage in packaged condition during transit from the supply source to the shipping point. The pack must, as a minimum, comply with rules and regulations applicable to the commodity and mode of transportation utilized."

Paragraph 5.3.1: Delete and substitute:

"5.3.1 Levels A and B - Intermediate packs prepared as specified in 5.2.1.1 shall be prepared for shipment by palletizing or unitizing on expendable wood pallets capable of bearing loads up to 2400 pounds. A unit or palletized load shall not exceed 2400 pounds gross weight. The preparation of the palletized load shall be in accordance with either MIL-L-35078 or MIL-STD-147. Insofar as practicable, palletized loads shall contain items of one part number, identical quantities and use uniform size and style pallets. A palletized load shall contain complete lots of tension bars only."

Paragraph 5.4.1: Delete and substitute:

"5.4.1 Additional marking - The following special markings shall be applied on the unit and intermediate packages as well as on the palletized load.

(a) Lot number and serial numbers on unit packages; lot numbers only on intermediate container and the palletized load. The marking on the palletized load shall prominently display the lot numbers contained thereon.

(b) Mark unit containers as follows:

"TOP - OPEN THIS SIDE ONLY"

Serial numbers on bars shall face the top of the container for quick inspection.

(c) Mark on unit and intermediate containers as follows:

"NOTICE - ISSUES SHALL BE MADE IN TOTAL LOT QUANTITIES: DO NOT BREAK LOTS"

ENCLOSURE 7

PROPOSED AMENDMENT 2 TO MILITARY
SPECIFICATION MIL-T-23436A(AS) OF 13 NOV. 1967.

1. (Essential) 5.2.1 Level A - Third sentence, delete "Class Domestic, Grade 275 (As A Minimum)" and substitute "Class Weather Resistant, Grade V3 (As A Minimum)".

Justification - Unit container becomes storage container when user (catapult personnel) removes one from intermediate container in catapult storage area aboard ship. This area is a salty atmosphere environment and also subject water wash; unit container may stay in storage there days or weeks depending on frequency of use and consequently, subject contents (tension bars) to corrosion due to inadequate protection.

2. (Essential) 5.2.2 Level C - Delete all reference to "Level C" and substitute "Level A" for packaging from supply source to ultimate user (catapult personnel).

Justification - To assure packaging will not inadvertently be shipped to user (catapult personnel) in a Level C pack. Field reports indicate this has occurred in the past with subsequent corrosion damage to these critical parts (tension bars).

3. (Essential) 5.4.1 Additional Marking - Add the following paragraph -

(d) "Critical item, if opened for inspection, represerve and repackage at Level A,Only."

Justification - Technical instructions insist on the safe physical condition (absence of corrosion or damage) of this item until actually used on catapult.

APP. F-3

4ND NAEC 4555/10A(6-69) REQUEST FOR SALVAGE ACTION SHEET 1 OF 1

CONTRACTOR/ACTIVITY: NAEC OR-4		NOMENCLATURE: FSN 1710-626-1326 LEVER		DATE: 4-11-72	ASSOCIATED: 72-605		
DWG./PART NUMBER: 501519-7	MODEL: MK	REV.: U	CONTRACT/SCHEDULE: UNKNOWN	SER. NO. 8	LOT SIZE 9	QTY. INSP. 10	QTY. REJ. 11

I. DESCRIPTION OF NON-CONFORMANCE

SEVERE RUST THROUGHOUT - ALL SURFACES.

2. A "HOLD! DO NOT ISSUE" TAG #12 DATED 4-11-7 HAS BEEN ATTACHED TO THE MATERIAL.

3. THE MATERIAL IS LOCATED IN BLDG #462 AT RREM, NSC.

4. UNIT PRICE: $ 416.00

5. CONTRACT WARRANTY IS NOT IN EFFECT.

6. RECOMMEND - SCRAP

II. REDUCTION IN PRICE (SPECIFY)

III. If salvage action is authorized, contractor is permanently card and supply reproductions of for the part(s) involved.

SIGNATURE OF COMPANY OFFICIAL

IV. DCASR/SHOP SUPERINTENDENT REVIEW

NOTE: ORIGINALS MUST BE SUBMITTED FOR PROCESSING AND DISTRIB

SIGNATURE OF DCASR/SHOP SUPERINTENDENT

V. NAEC DISPOSITION INSTRUCTIONS

☐ APPROVED ☐ DISAPPROVED

ENGRG DEPT

SCRAP AS RECOMMENDED.

4/20/72 CEB(NE

NAEC COMMENT PREPARED BY	NAEC COMMENT APPROVED BY	DATE	QUALITY ASSU
[illegible] 4/21/72	[illegible]		

VI. CONTRACTING OFFICE (NAEC)

APP. F-3

NAVAL ENG ICE PART 1027/0167 MOD 3

	B-8	C11-1	C-7	C11-2	C-13	C13-1	C013	
	M-2	M 4	[redacted]					
	M-2 MOD 3	M-7 MOD 1	M-7 MOD 2	M-2 [redacted]	B-5	C14-1	13-12	[redacted]
		A	A					

APPLICABILITY CHART

PART NO. 501549-7

LEVER ASSY

NSN 1710-626-1326

NSL 10-21-66	SOURCE CODE
QUANTITY PER ASSEMBLY 1	UNIT PRICE
QUANTITY PER CATAPULT	REPAIRABLE
QUANTITY PER ARRESTING GEAR 1	SHELF LIFE
WEIGHT 66.0	P.A.M.D.S. ACTIO
CUBE .45	

DATE 7-17-68

NOTES: [illegible]

Control Valve Assy Part No. 3 (VCA)

[illegible]

MR. DATA RECORD CARD ERASO FORM 17 (6-64 Rev.) (FORMERLY 4 ND-NAEC - 6302)

PACKING & PRESERVATION DATA

PRESERVATION-PACKAGING SHALL BE LEVEL "A" AS FOLLOWS: CLEAN IN ACCORDANCE PROCESS C-5 OF SPEC MIL-P-116E. PRESERVE WITH CORROSION PREVENTIVE COM SPEC. MIL-C-16173D. GRADE 2. PACKAGE INDIVIDUALLY IN ACCORDANCE WITH METHOD IA-1.4 OF SPEC MIL-P-116E. ITEMS PRESERVED-PACKAGED AS ABOVE SHALL PACKED LEVEL "B" FOR DOMESTIC SHIPMENTS AND LEVEL "A" FOR OVERSEAS SHIPMENT FOLLOWS: PACK IN A NAILED WOOD BOX, SPEC FED PPP-B-621 CLASS 1 OR CLASS 2 [redacted], GROUP 1 WOOD, [redacted] WITH SKIDS ON THE BOTTOM AND BATTENS ON TOP. AND BATTENS TO RUN THE FULL WIDTH OF THE BOX AND HAVE ENDS SQUARED. BOX CO TION TO PROVIDE FOR A COMPACT NON-SHIFTING LOAD. [redacted] PART NUMBER, FEDERAL NUMBER AND CONTRACT NUMBER TO BE PRINTED ON THE UNIT PACKAGE.

[illegible]

FORM 17 (BACK)

4ND NAEC 4855/10A(6-69) REQUEST FOR SALVAGE ACTION SHEET 1 OF 1

CONTRACTOR/ACTIVITY		NOMENCLATURE	DATE	RSA NUMBER
NAEC QA-4		FSN 4730-901-6287 UN: ON N4T	3-7-72	72-6028
DWG./PART NUMBER	MODEL	REV.	CONTRACT/SUBTASK	SER. NO.	LOT SIZE	QTY. INSP	QTY. REJ.
A414240-1	MK7		N00156-69-C-1744 AREO INC.		28	28	28

I. DESCRIPTION OF NON-CONFORMANCE

a. INADEQUATE PRESERVATION - FIRST STAGE OF RUST DUE TO NO PRESERVATIVE. All Pcs
2. A "Hold DO NOT ISSUE" TAG #22 DATED 3-7-72 HAS BEEN ATTACHED TO THE MATERIAL.
3. THE MATERIAL IS LOCATED IN BLDG. #312 AT OAK, NSC.
4. UNIT PRICE: $ 1.45.
5. RECOMMEND - CLEAN, PRESERVE & RE PACKAGE.
6. CONTRACT WARRANTY IS NOT IN EFFECT.

II. REDUCTION IN PRICE (SPECIFY)

III. If salvage action is authorized, contractor agr... permanently mark and supply reproductions of th... for the part(s) involved.

SIGNATURE OF COMPANY OFFICIAL

IV. DCASR/SHOP SUPERINTENDENT REVIEW

NOTE: ORIGINALS MUST BE SUBMITTED FOR PROCESSING AND DISTRIBUTI...

SIGNATURE OF DCASR/SHOP SUPERINTENDENT

V. NAEC DISPOSITION INSTRUCTIONS

☐ APPROVED ☐ DISAPPROVED

ENGINEERING COMMENT:

CONCUR WITH RECOMMENDATION.

NOTIFY COGNIZANT ACTIVITY DEFENSE INDUSTRIAL SUPPLY CENTER

NAEC COGNIZANT PREPARED BY	NAEC COMMENT APPROVED BY	DATE	QUALITY ASSURANCE
[signature] 4/3/72	[signature]	4/3/72	[signature]

VI. CONTRACTING OFFICE (NAEC)

1-41

APP. F-4

C-5769 (REV. 3-68)

FOR OR ACTIVITY	DEPT OR DIVISION	CONTRACT OR SCHEDULE NUMBER	RSA NUMBER
NAEC	Field Quality & Analysis Br. NF-33	Tech. Aero Co. N00156-69-C-1744	70-6053

	DWG/PART NO. AFFECTED	NOMENCLATURE	LOT & SERIAL NO.(S)	DATE
	A414240-1	Union Nut	4730-901-6287	6 May 197

ION (NAEC ONLY)	INSPECTOR (NAEC ONLY)	REASON (Reference)	SHEET 1 OF
seen	R. Sinclair	BRASO non-conforming material	

TION OF NON-CONFORMANCE (ATTACH DRAWING IF NECESSARY)

FIELD QUALITY ASSURANCE PROGRAM

. were inspected to Rev. G at JAX.
. were found not acceptable for the following reasons:

et and intermediate stages of rust on all pieces due to no preservation.

Piece Attached)

a. Tech Aero Inc. has gone bankrupt. The RSA represents 500 union nuts, P/N 414240-1, shipped to JAX.

b. 11000 ea. were shipped to NAEC. These were rejected and returned to tractor, then reshipped to NAEC.

NOTES:
1. "Hold, Do Not Issue" tag #17 dated 4/30 was placed on material.
2. This material is located in Bldg. #171.
3. Unit price of part is $2.20
4. Contract warranty is not in effect.

ED ACTION TO PREVENT RECURRENCE)

ION IN PRICE (SPECIFY)

/s/ R. Sinclair Ext. 3389/3722

IF THE RSA IS APPROVED CONTRACTOR AGREES TO PACKAGE ONE CONTRACTOR SUPPLIED REPRODUCTION OF THE APPROVE IN EACH PIECE COVERED BY THE RSA AT THE TIME OF SHIPMENT

SIGNATURE OF COMPANY OFFICIAL

VIEW / RECOMMENDATION:

SIGNATURE OF DCAS REP.

NGINEERING COMMENT

Per attached all pieces must be preserved
PROVED
Rust not acceptable.
DISAPPROVED
It is further noted that per NAEC P
and contract no. are on the pieces. This is a
major discrepancy and must be corrected
Pieces are to be returned to the vendor

NGINEERING COMMENT PREPARED BY	NAEL ENGINEERING COMMENT APPROVED
[illegible] Stel.	[illegible]

APP. F-5

NAEC-NAEC-2455(REV. 2-68)
PLATE NO. 11962

NAEC 4855/104(6-69) REQUEST FOR SALVAGE ACTION SHEET 1 OF 1

CONTRACTOR/ACTIVITY		NOMENCLATURE		DATE	RSA NUMBER
NAEC QA-4		3110-278-6952 RACE-INNER		2/9/72	72-6010
MFG./PART NUMBER	**MODEL**	**REV.**	**CONTRACT/SCHEDULE**	**SER. NO.**	**LOT SIZE**	**QTY. INSP**	**QTY. REJ.**
C677F0-47	SI	32	UNKNOWN			10 7	11 7

I. DESCRIPTION OF NON-CONFORMANCE

a. INADEQUATE PRESERVATION.
b. FIRST STAGE OF RUST ALL SURFACES.
c. SEVERE NICKS AND SCRATCHES ALL EDGES.
d. A "HOLD! DO NOT ISSUE" TAG #3, DATED 2/9/72, WAS ATTACHED TO MATERIAL.
e. THE MATERIAL IS LOCATED IN BLDG 721 AT OAK NSC.
f. UNIT PRICE: $11.50
g. CONTRACT WARRANTY IS NOT IN EFFECT.
h. RECOMMEND - SCRAP

II. REDUCTION IN PRICE (SPECIFY)

III. If salvage action is authorized, contractor agrees to permanently mark and supply reproductions of the marking for the part(s) involved.

SIGNATURE OF COMPANY OFFICIAL

IV. DCASR/SHOP SUPERINTENDENT REVIEW

NOTE: ORIGINALS MUST BE SUBMITTED FOR PROCESSING AND DISTRIBUTION

SIGNATURE OF DCASR/SHOP SUPERINTENDENT

V. NAEC DISPOSITION INSTRUCTIONS

☐ APPROVED ☐ DISAPPROVED

ENG. COMMENT:

CONCUR WITH RECOMMEND - SCRAP
NE722

NAEC COMMENT PREPARED BY	NAEC COMMENT APPROVED BY	DATE	QUALITY ASSURANCE
2/17/72			8/17

VI. CONTRACTING OFFICE (NAEC)

2/5

NAVSHIPS 0967-LP-000-0010 (REV. 2-68)
PLATE NO. 11968

APP. F-5

Name	INNER RACE
FSN	5RM 3110-275-6952
Superseded	
Superseded by	
Arresting Gear Repair Proc	
Cat Repair Procedure	
Cat Deck Gear & Acc Ser Bull	
Cat Deck Gear & Acc Ser Chg	
Cat Deck Gear & Acc Des Chg	
Service Bulletin	
Service Change	
Design Change	
N.O.	
IR - Date 28 June 66	
Component of C87750-11 for	
C66010-1 for 53-60099	
C66011-1 for 53-60100	

Applicability Chart

H-8	C11-1	C-7	C-13	C-13-1	CE1-3	Dead Load	MK
MK-5 MOD-3	MK-7 MOD-1	MK-7 MOD 2	MK-7 MOD 3	H-2 Modified	H-22	E-5 E 5-1	E1
	X	X	X				
D-28							

Quantity per Assembly	1	Source Code	
Quantity per Catapult		Unit Price	8-8-65
Quantity per Arresting Gear	36	Repairable	
Weight	30.5	Shelf Life	
Cube	.48	F.A.M.D.S. Action	
Notes			

Engr. Data Record Card BRASO Form 17 (Rev 3-65) Formerly 4ND-NAMC-6302

Preservation-packaging shall be Level "A" as follows:
Cleaning, preservation and packaging to be in accordance with Pack in a nailed wood box, Specified PPP-B-621, Class 1 (overseas). Group I wood, designed with skids on bottom and top. Skids and battens to run full width of box and have square. Box construction to provide for a ____ compact mounted.
Part Number, F.S.N. and Contract Number to be printed on unit packages or printed on labels firmly affixed to unit with pressure sensitive tape.

1000 cc PR 695/66 6-15-66
300 cc Type 3 Unit (Spare)
1500 cc PR 727/66 6-30-66
1500 cc PR 2354-22 8-8-66
1000 cc PR 730/66 6-15-66
25 cc PR 2541-A 9-16-66

BRASO Form 17 (back)

MATERIAL AND PROCESS REQUIREMENTS

NAVAL AIR ENGINEERING FACILITY (SHIP INSTALLATIONS)

AVAL AIR MATERIAL CENTER PHILADELPHIA 12, PA.

MPR 1262

DATE 9 June 195

REVISION	DATE
F	21 April
F	11 Oct 61
G	21 Aug 63

SHEET 1 OF 2

TLE: PRESERVATION, DEPRESERVATION AND LUBRICATION OF LER BEARINGS (OVER 6" O.D.) AND/OR SHEAVE SUB ASSEMBLIES LAUNCHING AND RECOVERY EQUIPMENT R 6 Oct 1969

Scope

1. This MPR covers materials and procedures for cleaning, preserving packaging, depreserving and lubricating of roller bearings (over 6" O.D.) and/or sheave and sheave sub assemblies for launching and recovery equipment.

Requirements

2. Cleaning

a. Remove the inner race with rollers and cage when applicable.

b. Clean in accordance with Spec. MIL-P-116D Method C5.

c. Immediately after cleaning, dry by Method D-1 or D-3 of Spec. MIL-P-116D. Drying by wiping is not permitted. The use of unfiltered compressed air for drying is not permitted due to the possibility of moisture or foreign matter entering the bearing or the scoring of the bearing due to rotation while in an unlubricated condition.

3. Preservation

a. Coat the inner race and rollers with cage with corrosion preventive compound conforming to Spec. MIL-C-16173C Gr. 2. Coat the outer race with the same compound whether the race is furnished separately or installed in a sheave.

4. Packaging

a. Individually wrap each unit tightly with a shape conforming overlap wrap ("tire" or "doughnut" wrap) using crepe paper material conforming to Spec. MIL-B-121, Type II, Grade A, Class 2. The inner race, rollers with cage, and the outer race when furnished separately shall be doughnut wrapped with aluminum foil, Spec. MIL-A-148A, Type 3, dry annealed, .003" thick and then coated with strippable protective compound conforming to MIL-P-149A, Type II. The strippable protective coating shall be of uniform thickness 0.050" minimum. The inner race, cage with rollers and the outer race when furnished separately shall be packaged individually in fibreboard containers conforming to Spec. PPP-B-636, Type 1 or 2, Class 1, Style R.S.C. Bearings packed in a container with a sheave assembly shall be blocked and braced to prevent physical contact of one to the other and to provide for a compact non-shifting load.

APP. F-6

NAEC	SHEAVE SUB-ASSY	14 [illegible]	11 [illegible]

DWG./PART NUMBER	REV.	CONTRACT/SCHEDULE	SER. NO.	LOT SIZE	QTY. REC'D	QTY. REJ
509185-3	D	UNKNOWN			3	1

I. DESCRIPTION OF NON-CONFORMANCE — FSN 1710-911-1702

a. THERE IS SEVERE RUST THROUGHOUT THE IRE SURFACE OF THE INSIDE DIAMETER OF E OUTER RACE.

b. THE SHEAVE & BOTH PHENOLIC SPACER. E BEEN BADLY DAMAGED THROUGH HANDLING.

c. THERE IS NO PRESERVATIVE OR WRAPPIN THE ITEM. THIS IS OFF-LOADED MATERIAL FRO ARRIER AND DUE TO THE ABOVE MENTIONED REPAINCIES IT IS THE WRITERS OPINION IS UNFIT FOR SHIPBOARD USE AND SHOULD SCRAPPED.

II. REDUCTION IN PRICE (SPECIFY)

III. If salvage action is authorized, contractor eg permanently mark and supply reproductions of t for the part(s) involved.

SIGNATURE OF COMPANY OFFICIAL

IV. DCASR/SHOP SUPERINTENDENT REVIEW

NOTE: ORIGINALS MUST BE SUBMITTED FOR PROCESSING AND DISTRIBU

SIGNATURE OF DCASR/SHOP SUPERINTENDENT

V. NAEC DISPOSITION INSTRUCTIONS

☐ APPROVED ☐ DISAPPROVED

NOTES:

1. "HOLD, DO NOT ISSUE" TAG # 3 DATED 1/15/71 WAS PLACED ON MATERIAL.
2. THIS MATERIAL IS LOCATED IN BLD ORIS.
3. UNIT PRICE OF PART IS $334.00

ENGR COMMENT: NE-722

SCRAP

B. MANCINI

NAEC COMMENT PREPARED BY	NAEC COMMENT APPROVED BY	DATE	QUALITY ASSURA
MANCINI 722			

VI. CONTRACTING OFFICE (NAEC)

APP. F-6

Part No. 5091852-3

Name Plate Sub-Assy	C11-1	C7	C-13	C15-1	MK 7-1	MK 7-2			
FSN 5340-[illegible]-1052						6	1		
Supersedes									
Superseded by	C11-3	C-21	C-23	D15 C27	E5 E5-1				
Arr. Gear Rep. Proc.									
Cat Repair Proc.					72				
C.D. & Acc Ser Enl.									
C.D.G. & Acc Ser Cog.	ICL Qty. per Equip/Vessel/Fld.								
C.D.G. & Acc. Des Cog.	Qty. per Sub/Fld.						Sample Data		
Serv. Enl.	Qty. Per Assy.			1			Unit price		
Serv. Cog.	Qty. per Cat.						Fund code		
	Qty. per Arr. Gear			2.5			Shelf life		
Des. Cog.	Weight		Cube				ESD [illegible]		
E.O.	Notes: Preservation-Packaging [illegible]								
ECP	Date 6/30/72.								
Component of									
5091852-1									

ENTR. DATA RECORD CARD RMSO FORM 17 (Rev. 9-71) Formerly [illegible] (Use front)

Preservation-packaging shall be Level "A" as follow Cleaning, preservation and packaging is to be in acc with ITEM 1262.

ITEMS PRESERVED-PACKAGED AS ABOVE SHA
PACKED LEVEL "B" FOR DOMESTIC SHIPMENTS AND LEVEL "A" FOR OVERSEAS SHIPME
FOLLOWS: PACK IN A NAILED WOOD BOX, SPEC FED PPP-B-621 CLASS 1 OR CLASS
UIRED, GROUP 1 WOOD, DESIGNED WITH SKIDS ON THE BOTTOM AND BATTENS ON TOP
AND BATTENS TO RUN THE FULL WIDTH OF THE BOX AND HAVE ENDS SQUARED. BOX
TION TO PROVIDE FOR A COMPACT NON-SHIFTING LOAD. [redacted] PART NUMBER, FEDER
NUMBER AND CONTRACT NUMBER TO BE PRINTED ON THE UNIT PACKAGE.

1	300 TDR 6/30/72
2	150 TDR 2/3/73 11/30/2
3	
4	SEE APP. F-5 FOR MIL-P-1252
5	

ON OR ACTIVITY	DEPT OR DIVISION	CONTRACT OR SCHEDULE NUMBER	DCA SUPPL
	Field Quality & Analysis Br. QA-4	Unknown	71-6125 XXXX

	DWG/PART NO. AFFECTED	NOMENCLATURE	LOT & SERIAL NO.(S)	DATE
A/C	53-40112-2	Spacer	1710-315-9862	7/21/71

(NAVY ONLY)	INSPECTOR (NAVY ONLY)	REASON (Reference)	SHEET
N FORM	J. SENKARIK J. YANKUS	BRASO Nonconforming material	1

TYPE OF NON-CONFORMANCE (ATTACH DRAWING IF NECESSARY)

FIELD QUALITY ASSURANCE PROGRAM

. were inspected to Rev. H at Jacksonville, Fla.
. were found not acceptable for the following reasons:

ho pieces are dished from .015 to .020 instead of the .005 maximum
ed by the drawing.

ll pieces are in the first stage of rust.

1. "Hold, Do Not Issue" tag #28 dtd 6/7/71 was placed on material.
2. This material is located in Bldg 6171.
3. Unit Price of part is $12.00
4. This is off-load material USS SARATOGA.

B ACTION TO PREVENT RECURRENCE:

/s/ J. SENKARIK/J. YANKUS
x2014/3722

ION IN PRICE (SPECIFY)

IF THE DCA IS APPROVED CONTRACTOR AGREES TO PACKAGE ONE CONTRACTOR SUPPLIED REPRODUCTION OF THE APPRO
IN EACH PIECE COVERED BY THE DCA AT THE TIME OF SHIPMENT

SIGNATURE OF COMPANY OFFICIAL

TION / RECOMMENDATION:

SIGNATURE OF DCAS REP.

NEERING COMMENT NE-722

VED -1 THE ABOVE PIECES ARE NOT
APPROVED ACCEPTABLE.

B. MANCINI 7-26-

NEERING COMMENT PREPARED BY: SB

NAEC ENGINEERING COMMENT APPROVED: [signature]

AND-NAEC-2455(REV. 2-68)

PLATE NO. 11968

APP. F-7

-3704 (REV. 3-68)

OR OR ACTIVITY		DEPT OR DIVISION	CONTRACT OR SCHEDULE NUMBER	NSA NUMBER
EC		Field Quality & A Analysis Br. NF-33	Unknown	69-6176
	DFG/PART NO. AFFECTED	NOMENCLATURE	LOT & SERIAL NO.(S)	DATE
	53-40112-2	Inner Spacer	1710-315-9562	10 Dec 196
(NAEC ONLY)	INSPECTOR (NAEC ONLY)	REASON (Reference)		SHEET 1 OF 2
ien	C. Turner	Non-conforming material		

ON OF NON-CONFORMANCE (ATTACH DRAWING IF NECESSARY)

FIELD QUALITY ASSURANCE PROGRAM

were inspected to Rev. M at Boston Naval Shipyard
were found not acceptable for the following reasons:

1) Boston Shipyard Insp. Report #1674
2) Boston Shipyard spdltr #540-2816 of 1 Dec 1969

de diameter is from .005 U/S to .018 O/S and out of round.
eces rusty, pitted and dished.
in accordance with flatness requirements.
material had been preserved by NAEC on schedule #42417-003 of March 1969.

es (1) and (2) are forwarded for further information.

NOTES:
1. "Hold, Do Not Issue" tag #4 of 12/3/69 was placed on material.
2. This material is located in Bldg. #199/5th floor - Code 540.
3. Unit Price of part is $12.00
4. Contract warranty is not in effect.

(CONTINUED)

CTION TO PREVENT RECURRENCE)

IN PRICE (SPECIFY)

HE NSA IS APPROVED CONTRACTOR AGREES TO PACKAGE ONE CONTRACTOR SUPPLIED REPRODUCTION OF THE APPROVED ACH PIECE COVERED BY THE PSA AT THE TIME OF SHIPMENT

SIGNATURE OF COMPANY OFFICIAL

/ RECOMMENDATION)

SIGNATURE OF DCAS REP.

EERING COMMENT

ED

OVED SCRAP ALL Above.

EERING COMMENT PREPARED BY | NAEC ENGINEERING COMMENT APPROVED

NAVAIR-NAEC-2455(REV. 2-68)

PLATE NO. 11963

APP. F-7

53-40112-2

STEEL - INNER STEEL

MIL-P-315-4532 SCNG

SUPERSEDES

SUPERSEDED BY

T. DECK GEAR & ACC. SER. BULL.

T. DECK GEAR & ACC. SER. CHG.

RVICE BULLETIN

RVICE CHANGE

IGN CHANGE

AIR PROCEDURE # 45*

D.

R DATE 1 MARCH

PONENT OF FOR

-00211-1 FOR MK7-3

FOR

FOR

APPLICABILITY CHART

N-8	C11-1	C-7	C11-2	C-13	C13-1	TC13	FDC-1
MK-2	MK 4	NOSE GEAR JOG					
MK-5 MOD 1	MK-5 MOD 3	MK-7 MOD 1	MK-7 MOD 2	HOREST	E-5	E14-1	MA-1A
		X	X				

NSL	10-3-66	✓	SOURCE CODE
QUANTITY PER ASSEMBLY		20	UNIT PRICE
QUANTITY PER CATAPULT			REPAIRABLE
QUANTITY PER ARRESTING GEAR		40	SHELF LIFE
WEIGHT		5.5	P.A.M.D.S. ACTION
CUBE		.09	

NOTES: * Method in remarks, hand coated

NAVAIR DATA RECORD CARD BRASO FORM 17 (5-63) (FORMERLY NND - NAMC - 6302) (OVER)

PACKING & PRESERVATION DATA

PRESERVATION-PACKAGING SHALL BE LEVEL "A" AS FOLLOWS: CLEAN IN ACCORDANCE PROCESS C-1 OF SPEC MIL-P-116E. PRESERVE WITH CORROSION PREVENTIVE CO SPEC. MIL-C-16173D. GRADE 2. PACKAGE INDIVIDUALLY IN ACCORDANCE WIT METHOD IA-8 OF SPEC MIL-P-116E. ITEMS PRESERVED-PACKAGED AS ABOVE SHAL PACKED LEVEL "B" FOR DOMESTIC SHIPMENTS AND LEVEL "A" FOR OVERSEAS SHIPMEN FOLLOWS: PACK IN A NAILED WOOD BOX, SPEC FED PPP-B-621 CLASS 1 OR CLASS 2 UIRED, GROUP 1 WOOD, DESIGNED WITH SKIDS ON THE BOTTOM AND BATTENS ON TOP. AND BATTENS TO RUN THE FULL WIDTH OF THE BOX AND HAVE ENDS SQUARED. BOX C TION TO PROVIDE FOR A COMPACT NON-SHIFTING LOAD. PART NUMBER, FEDERA NUMBER AND CONTRACT NUMBER TO BE PRINTED ON THE UNIT PACKAGE.

1		12 MAR. PC 2283-22
2	10 JAN PR 77162	
3	PR 17717 7/17/66	
4		PR 18165
5	160 TOR 19219	

BRASO FORM 17 (BACK)

NAVMAT-NAEC-2455(REV. 2-68)

PLATE NO. 11962

APP. F-8

ACTOR OR ACTIVITY	DEPT OR DIVISION	CONTRACT OR SCHEDULE NUMBER	PSA NUMBER
C	Field Quality & Analysis Branch	Brutons 156-68-C-2006	70-6082

	DRG/PART NO. AFFECTED	NOMENCLATURE	LOT & SERIAL NO.(S)	DATE
epults C11	29-40707-775	Cable	1720-592-1989	5/18/70

PERSON(NAEC)	INSPECTOR (NAEC ONLY)	REASON (Reference)	SHEET
ANROSEN	J.Senkarik J. Yankus	Inadequate preservation	1

DESCRIPTION OF NON-CONFORMANCE (ATTACH DRAWING IF NECESSARY)

FIELD QUALITY ASSURANCE PROGRAM

reels were inspected to Rev. "G" at Oakland.
reels were found not acceptable for the folloiwng reasons:

There is a definite lack of preservation present on the wire rope. Due to s inadequacy, the material is in the first stage of rust.

E: 1. "Hold, Do Not Issue" tag-#23 dated 5/13/70 was placed on material.
2. This material is located in Bldg. #724.
3. Unit Price of part is $201.00.
4. Contract warranty is not in effect.

/s/ J. Senkarik
J. Yankus, ext 3389

NEED ACTION TO PREVENT RECURRENCE)

CTION IN PRICE (SPECIFY)

IF THE MSA IS APPROVED CONTRACTOR AGREES TO PACKAGE ONE CONTRACTOR SUPPLIED REPRODUCTION OF THE APPL WITH EACH PIECE COVERED BY THE PSA AT THE TIME OF SHIPMENT

SIGNATURE OF COMPANY OFFICIAL

REVIEW / RECOMMENDATION)

SIGNATURE OF USN REP.

ENGINEERING COMMENT

APPROVED

DISAPPROVED

(1) The above report indicates inadequate preservation. Rust should be removed and the wire rope preserved.

(2) Additional information on the degree of corrosion on the wire rope indicate that the rope is unacceptable for use. Comp. Engr 6/5/70

ENGINEERING COMMENT PREPARED BY

NAEC ENGINEERING COMMENT APPROVED

NAVAIR-2455(REV. 2-68)
PLATE NO. 11962

Part No. 29-40707-775-0 Ft. Main Cat Arrestor

Name Cable Assy-Det Gear	C11-1	C7	C-13	C13-1	MK 7-1	MK 7-2	MK 7-3	LEAD LOAD	
FSN 5EM1720-592-1959	X	X	X	X					
Supersedes									
Superseded by	C11-3	L-21	E-28	E15 E27	E5 E5-1	M-1A			
AC/CAT. REP. PROC.									
C.D. & Acc. Ser. Bul.					FLA				
C.D.C. & Acc.Ser.Chg. X Ea Launch	29-40707-530								
C.D.C. & Acc.Des.Chg.	ICL Qty. per Equip/Vessel/FLD.								
Serv.Bul.	Qty. per Ship/Fld.						Source Code		
Serv.Chg.	Qty. Per Assy. 4						Unit price 5		
	Qty. per Cat. 4						Repairable		
Des Chg.	Qty. per Arr. Gear						Shelf Life		
E.O.	Weight #438 Cube 8cu ft						E1090 Action		
BIR DATE 9-1-64	Notes: Tail Barrier Engagement Cable Assy.								
Component Of	Tail Barrier Engagement Cable Assy. 29-40707								
00-61310 for 29-61321	for F-14A, A-7E Aircraft. 9-1-6								
00-61509 " 29-61322	CV#1,3 CAT #2 #1 CBY 29-40707-775								
29-61319 29-61320 29-61957	Chart Utilized, Cat. Line Anl. 28"OD x 19'								
	Wire Rope Length W.P. 500 Lbs. 8 cu. ft.								

ENGR. DATA RECORD CARD BRASO FORM 17 (Rev. 8-71) Formerly 4WD-NAMC-5302 (See Ov

PACKING & PRESERVATION DATA

rvation-packaging shall be Level "A" as follows: Clean cable fitting in acc
Process C-1 of Spec. MIL-P-116E. Preserve fitting with corrosion preventive

MIL-C-16173D, Grade 2 and wrap with grease proof barrier paper, Spec. MIL-B
A, Type 2, Class 2, securely attached with pressure sensitive tape. Preser

1 of Spec. MIL-C-16173D. Items preserved-packaged as above shall be packed

ws: Pack one each cable on a commercial type reel with cable fitting reeled
Cover outer periphery of wire rope with grease proof barrier material, Spe
A, Type 2, Class 2. Cover outside diameter of each reel with solid blocked
Item Identification; Federal Stock Number to be added to item identificatio
called out on Note #1 of Drawing.

SEE APP. D. FOR NEW PACKG

Sec. FF-334/8 Amdt. FF-141/67
Amdt. TD-6054 Ind 2-3648 FF-334/8 Amdt. FF-366/72 2-16-72
Amdt-JR-8654 (Cancelled)
Amdt. FF-264/71 16-8-75. Will Expire to be Revised Thru... 11/3/70
Amdt. F-D-1-2582 11/3/75 FF 2204-2368 - 500 Lb 7/27/72

BRASO FORM 17 (BACK)

TOR OR ACTIVITY	DEPT OR DIVISION	CONTRACT OR SCHEDULE NUMBER	RSA NUMBER
NAEC	Field Quality & Analysis Br., NF-33	Mack Equipment N156-41035	69-6146

	DWG/PART NO. AFFECTED	NOMENCLATURE	GOV'T SERIAL NO.(S)	DATE
Mod 1	408402-1	Sleeve	1710-896-7199	23 Sep 19(

ORIGINATOR ONLY:	INSPECTOR (NAEC ONLY)	REASON (Reference)	SHEET 1 OF
Keen	F. Belfus J. Yankus	Non-conforming material	

DESCRIPTION OF NON-CONFORMANCE (ATTACH DRAWING IF NECESSARY)

FIELD QUALITY ASSURANCE PROGRAM

:s. were inspected to Rev. C at Yokosuka.
:s. were found not acceptable for the following reasons:

The 3.750^{+002}_{-000} inside diameter is chrome plated and the condition of the :ing is considered poor.

All surfaces not plated are in the second degree of rust due to absence reservation.

This material is in the same condition as previously reported on NAEC RSA 3246.

(CONTINUED)

DISPOSITION OF NONCONFORMANCE:

USA IN PRICE (SPECIFY)

IF THE MRA IS APPROVED CONTRACTOR AGREES TO PACKAGE THE CONTRACTOR SUPPLIED REPRODUCTION OF THE APPROVED ITEM WITH EACH PIECE COVERED BY THIS RSA AT THE TIME OF SHIPMENT

SIGNATURE OF COMPANY OFFICIAL

REVIEW / RECOMMENDATIONS:

SIGNATURE OF DCAS REP.

ENGINEERING AUTHORITY:

APPROVED

DISAPPROVED

Sleeves are not acceptable unless inside diameter is replated and rust is removed to restore all characteristics as specified on drawing.

E. Lawin 3 Oct. 69

ORIGINATING COMMENT PREPARED BY

NAEL ENGINEERING COMMENT APPROVED

APP. F-9

208402-1

NAME SLEEVE

FSN 1710-896-7179 (Navy)

SUPERSEDES 402765-1

SUPERSEDED BY

REPLACED BY

ADDED TO

SERVICE BULLETIN

SERVICE CHANGE MK 7-2 171

DESIGN CHANGE MK 7-2 167

MIL-C-61-246

DATE 15 APR 61

COMPONENT OF Catapult Runout Valve

05318-2 FOR

FOR

FOR

APPLICABILITY CHART								
00-10	00-12	00-13	00-14	00-15			
MK5	MK7-1	MK4	MOREST	MK7-2	IMPLUS		
				X			
02-20	02-22	02-23	02-24	02-25	03-1		

NSL	X	SOURCE CODE
QUANTITY PER ASSEMBLY	1	ACCOUNTABILITY
QUANTITY PER CATAPULT		UNIT PRICE
QUANTITY PER ARRESTING GEAR	1	REPAIRABLE
WEIGHT	27.	SALVAGEABLE
		CUBE

NOTES: MIL-C-61-245 BRASO to receive 15 ea 4

MR. DATA RECORD CARD BRASO FORM 17 (10-60) (FORMERLY BND-NAEC-6302)

PACKING & PRESERVATION DATA

Clean in accordance with Process C-1 of Spec. MIL-P-116D. Pr corrosion preventive compound, Spec. MIL-C-16173B, gr. 2. In wrap in grease proof barrier material, Spec. MIL-B-121A, grad Class 2, secufely attached with pressure sensitive tape. Pac in a fiberboard container, Spec. Fed. PPP-B-636, Type II, Cla F.T.C. The box shall be ~~securely~~ secured by tape conforming PPP-T-60, Type 2, Class 2. Pack 10 each in a nailed wood box PPP-P-621, Class 1, group one wood, designed and constructed for a compact non-shifting load. Item identification to be i with Method "A" of BRASO Memo. S83/(6568) of 18 Jan '57.

113 ea NR 5

201 ea PR 12

REQUISITION

1

2

3

4

5

BRASO FORM 17 (BACK)

AND-NAEC-2455(REV. 2-68)

PLATE NO. 11962

APP. F-10

R OR ACTIVITY	DEPT OR DIVISION	CONTRACT OR SCHEDULE NUMBER	RSA NUMBER
Rope	Field Quality & Analysis Br. NF-33	156-46677	68-6046

	DWG/PART NO. AFFECTED	NOMENCLATURE	LOT & SERIAL NO.(S)	DATE
	A-92791-27-1750-0	wire rope	4010-993-1782	30 April 19

(NAEC ONLY)	INSPECTOR (NAEC ONLY)	REASON (Reference)	SHEET 1 OF 1
sen	F. Belfus		

ON OF NON-CONFORMANCE (ATTACH DRAWING IF NECESSARY)

1 pc. inspected to Rev. 36 at NORVA.
1 Pcs. not acceptable for the following reasons:

a. Outer periphery of reel does not have any greaseproof barrier material applied.

b. Outside of reel has half the lagging missing.

c. The wire rope is in the first stages of rust and appears etched by the rust in individual wires.

NOTES:
1. "Hold, Do Not Issue" tag #3 dated 4/30/68 was placed on material.
2. This material is located in Bldg. #423.
3. Unit Price - $2,170.00
4. Contract Warranty: No

ACTION TO PREVENT RECURRENCE:

/s/ FRED BELFUS EXT. 3722/3389

(IN PAICE (SPECIFY)

THE RSA IS APPROVED CONTRACTOR AGREES TO PACKAGE ONE CONTRACTOR SUPPLIED REPRODUCTION OF THE APPROVED EACH PIECE COVERED BY THE RSA AT THE TIME OF SHIPMENT

SIGNATURE OF COMPANY OFFICIAL

(W / RECOMMENDATION:

SIGNATURE OF DCAS REP.

INEERING COMMENT

Scrap

IOVED

6/3/68

PPROVED

NEERING COMMENT PREPARED BY

MINE

NAEL ENGINEERING COMMENT APPROVED

Part No. A92791-27-1750-0 * [illegible] FAIRCHILD ENGINE MK 7 MOD 1

Name PURCHASE CABLE

FSN R4010-993-1782-KCAG

Supersedes 405112-33-1750

Superseded by 507952-3

Arresting Gear Repair Proc.

Cat Repair Procedure

Cat Deck Gear & Acc Ser Bull

Cat Deck Gear & Acc Ser Chg

Cat Deck Gear & Acc Des Chg

Service Bulletin

Service Change MK 7 A.G. #205

Design Change

E.O.

BIR Date 20 MARCH 66

Component of for

for

for

Applicability Chart

M-8	C11-1	C-7	C-13	C-13-1	CE1-3	Deck Load	MK-2
MK-5 MOD-3	MK-7 MOD-1	MK-7 MOD 2	MK-7 MOD 3	M-2 Morest	M-21	E-5 E 5-1	E14-1
	X					—	

Quantity per Assembly		1	Source Code
Quantity per Catapult			Unit Price
Quantity per Arresting Gear			Repairable
Weight	1/T	5277	Shelf Life
Cube	F F	.520	P.A.M.D.S. Action

Notes * Add-REF'D AS IDENTICAL TO 405112-33
SEE 507952-3 FOR NEW PROCUREMENT FOR BARRI
* ISSUE UNTIL EXHAUSTED. NOW
TO BE 507952-3

Engr. Data Record Card BRASO Form 17 (Rev 3-65) Formerly 4ND-NAMC-6302 (se

Class 2.

Packing and Preservation Data

The wire rope shall be protected from corrosion during shipment and storage preserving with corrosion preventive compound, SPEC. MIL-C-11796, Grade 1. Compounds shall be applied over the entire length of the rope prior to final wrapping it shall cover all exposed wire surfaces and penetrate the crevices between strands. Wire rope shall be wound on substantial commerical type reels. Cover periphery of reel with grease proof barrier material, SPEC. MIL-B-121, Grade 2. Outside of each reel shall be enclosed with solid blocked wood sheathing. Thickness of sheathing and/or lagging shall be equal or greater than that of the outside flanges but not thicker that nominal 2" lumber and shall be positioned so that sheathing and/or lagging touch[illegible] sheathing and/or lagging. Federal Stock Number to item identification requirements of drawing.

Requisition

1 [illegible]
2
3
4
5

SEE APP. D-2 FOR NEW PACKAGING

BRASO Form 17 (back)

8788 (REV. 9-66)

SR OR ACTIVITY	DEPT OR DIVISION	CONTRACT OR SCHEDULE NUMBER	RSA NUMBER
MPEX	Field Quality & Analysis Br. NF-33	N156-43541	68- 6026

	DWG/PART NO. AFFECTED	NOMENCLATURE	LOT & SERIAL NO.(S)	DATE
	A92791-13-600	Cable	4010-663-8046	19 Feb 19

R(NALC ONLY)	INSPECTOR (NAEC ONLY)	REASON (Reference)	SHEET OF
anRose	F. Belfus		1

TION OF NON-CONFORMANCE (ATTACH DRAWING IF NECESSARY)

FIELD QUALITY ASSURANCE PROGRAM

eces inspected to Rev. 36 at Long Beach, Calif.
eces not acceptable for the following reason:

a. There is rust on wires in strand. Rust appears on strands towards
de of wire rope. When rust is wire brushed for removal, a visual
ination reveals wires and strands to be etched or pitted because of rust.

:S: 1. "Hold, Do Not Issue" tag #4, dated 1-31-68, was placed on material.
2. This material is located in Bldg. 55.
3. Unit Price - $316.
4. No contract warranty in effect.

/s/ FRED BELFUS - Ext. 3722
/s/ JOHN BRANCU - Ext. 3722

D ACTION TO PREVENT RECURRENCE)

ON IN PRICE (SPECIFY)

F THE RSA IS APPROVED CONTRACTOR AGREES TO PACKAGE ONE CONTRACTOR SUPPLIED REPRODUCTION OF THE APPROVED
N EACH PIECE COVERED BY THE RSA AT THE TIME OF SHIPMENT

SIGNATURE OF COMPANY OFFICIAL

IEW / RECOMMENDATION:

SIGNATURE OF DCAS REP.

IGINEERING COMMENT

PROVED SCRAP 3NE722 2/20/68

APPROVED

ISSUED BY .....

DATE .....

GINEERING COMMENT PREPARED BY	NAEL ENGINEERING COMMENT APPROVED
BJES 3NE722	

APP. F-10

MK-2	MK 4	NOSE GEAR ICN.						
MK-5 MOD 1	MK-5 MOD 3	MK-7 MOD 1	MK-7 MOD 2	NOREST	E-5	E1 4-1	MA-1A
	X						

APPLICABILITY CH

E 92791-13-6000
PURCHASE CHGE
4010-663-3096
C92791-2-1200
DECK GEAR & ACC. SER. BULL.
DECK GEAR & ACC. SER. CHG.
SVICE BULLETIN
SVICE CHANGE
154 109
SIGN CHANGE
PAIR PROCEDURE
DATE 15 DEC 69
MPONENT OF FOR
FOR
FOR
FOR

NSL	3-23-67	X	SOURCE CODE
QUANTITY PER ASSEMBLY		2	UNIT PRICE
QUANTITY PER CATAPULT			REPAIRABLE
QUANTITY PER ARRESTING GEAR		2	SHELF LIFE
WEIGHT	per foot TOTAL	2.03 (218)	P.A.M.D.S. ACTION
CUBE			

NOTES: 2 1/2" 2WP GALV 2 SWAGE
X-C92791-13-600 replaced by C927
(Twelve) per MK 5 AG Sys Chg
DN June 6

DATA RECORD CARD BRASD FORM 17 (5-69) (FORMERLY AND - NAMC - 6302) (OVER)

PACKING & PRESERVATION DATA

E ROPE SHALL BE PROTECTED FROM CORROSION DURING SHIPMENT AND ED STORAGE BY
H CORROSION PREVENTIVE COMPOUND SPEC. MIL-C-16173D, GRADE ONE (1) (HARD DRY
COMPOUND SHALL BE APPLIED OVER THE ENTIRE LENGTH OF ROPE PRIOR TO REELING
LL OVER ALL EXPOSED WIRE SURFACES AND PENETRATE THE CREVICES BETWEEN WIRES
WIND UP ON A COMMERCIAL TYPE REEL. WRAP OUTER LAYER OF WIRE ROPE WI
MATERIAL SPEC. MIL-B-121, TYPE 2, GRADE A, CLASS 2,. COVER OUTE
ADD FSN or item identifi

O-NAEC-5795 (REV. 5-62)

E. Hartford, Conn.

CONTRACTOR'S NAME		CONTRACTOR'S NUMBER	DATE
156-43863 PLATT MFG. CO.		NAEL (SI) #66-6050	14 Apr
CL	DRAWING/PART NO. AFFECTED	TITLE	
C-13	408084-2	Track Section FSN 1720-225-0590	

QUALITY ASSURANCE PROGRAM

168 pieces inspected to Revision "G" at BREM.

85 pieces not acceptable as follows:

a. Zinc chromate primer is peeling off and pieces are rusting.

NOTE: 1. "Hold, Do Not Issue" tag #3, dated 3-31-66, was placed on materia

2. Unit Price - $16.50

3. Material is within contractual warranty.

/s/ J. Yankus - Ext. 3722

NF-6 Ref: 2915182 of 29 Mar 1966

APP. F-11

	408084-2
NAME	Jack B. Sexton
SUPERSEDES	408084-1
SUPERSEDED BY	408084-3
CAT. DECK GEAR & ACC.	D.C. # 93 Fig 25
CAT. DECK GEAR & ACC. SER. CHG.	#111 thru 197
SERVICE BULLETIN	
SERVICE CHANGE	
DESIGN CHANGE	
E. O.	
DIR / DATE	
COMPONENT OF	General Arrangement FOR
	FOR
608629	FOR Bow Cat
608630	FOR Waist Cat
	FOR

APPLICABILITY CHART

MK-2	MK 4	NOSE GEAR ION					
MK-5 MOD-1	MK-5 MOD-3	MK-7 MOD 1-3	MK-7 MOD 2-3	MOREST	E-5	E1 4-1	MA-

NSL			SOURCE CODE
QUANTITY PER ASSEMBLY	Both Cats	80	UNIT PRICE
QUANTITY PER CATAPULT	Bow Cat	52	REPAIRABLE
QUANTITY PER ARRESTING GEAR			CUBE
WEIGHT	Appx.	17.	

NOTES 408084-2 can be used in ... drilling and countersinking 2 additional ... # 408084-2 Items 2 & 3 ... 1 (ea) Deck Gear & Acc. Ser. Chg. #197 ...

ENGR. DATA RECORD CARD BRASO FORM 17 (2-63) (FORMERLY NND - NAMC - 6302) (OVE

PACKING & PRESERVATION DATA

[NO PRESERVATION REQUIRED. PACKAGE INDIVIDUALLY IN ACCORDANCE WITH METHOD ... MIL-P-116 D, IN A COMMERCIAL TYPE CARD BOARD BOX.] PACK 2 EACH IN A NAI... SPEC. FED. PPP-B-621, CLASS 2, GROUP ONE WOOD, DESIGNED WITH SKIDS ON BOT... ON TOP. SKIDS AND BATTENS TO RUN FULL WIDTH OF BOX AND HAVE ENDS SQUARED ... TO PROVIDE FOR A [illegible] COMPACT, NON SHIFTING LOAD. ITEM IDENTIFICATION, ... NUMBER IS TO BE ADDED TO ITEM IDENTIFICATION REQUIREMENTS CALLED OUT ON D...

[ ] FACTORY P&P

NAVAIR-NAEC-2455 (REV. 2-68)
S/N 0105-LF-000-2455

APP. F-11

[illegible] 405084-3 *	151 0/2
TRACK SECTION	
NR 1720-945-7359	
Supersedes 405084-2	
Superseded by 405084-4 *	
Arresting Gear Repair Proc	
Repair Procedure 1720-514-3501	
Deck Gear & Acc Ser Bull	
Deck Gear & Acc Ser Chg	
Deck Gear & Acc Des Chg	
Service Bulletin	
Service Change	
Design Change	
Date 1/16/68	
Component of for General Arrangement	
608649 for	
608650 for	

Applicability Chart

H-8	C11-1	C-7	C-13	C-13-1	CC1-3	(Blank) Load	MK-2
	X	X	X	X			X
MK-5 MOD-3	MK-7 MOD-1	MK-7 MOD 2	MK-7 MOD 3	M-2 Moreat	M-21	E-5 E-5-1	E14-1
E-28							

!OL Qty per Equipment/Vessel

Quantity per Assembly		Source Code
Quantity per Catapult	4 per set	Unit Price
Quantity per Arresting Gear		Repairable
Weight	14.	Shelf Life
Cube	0-15	P.A.M.D.S. Action

Notes 405084-3 can be made from -2 by CUT Deck Gear & Acc Ser Chg No. 1 DO NOT PROCURE. Fill UNTIL EXHAUSTED. USE TO BE STENCILED P/N 405084-3

Data Record Card BRASO Form 17 (Rev 3-65) Formerly NAVAER 6300 C.D.G. & Acc. Ser. Bul # 219

Packing and Preservation Data

Pack in accordance with Procedure C-1 of Spec. MIL-P-116E. Preservative Corrosive Compound Spec. MIL-C-16173D, Grade 3. Packing in accordance with Method IA-15 of Spec. MIL-P-116E a nailed wood box, Spec Fed. PPP-B-621 Class 1 or Class 2 with 2 wood with skids on bottom and bottoms on top. Skids shall be one set width of box and have rods sufficient to provide for a compact non-shifting load. Until final Stock Number and Contract Number to be provided by Supply.

Discussion with Mr Sharbaugh, Dwgs to be changed to omit Zinc Chromate (Green). To be processed in accordance with Method IA-15 of Spec MIL-P-116E as modified by CAIC's Memo dtd 1/16/68

UNKNOWN		NAEL (SI) #66-6037	28 Fe
AM 7	400790-1	Socket Eye End FSN 4RM1710-315-9631	

QUALITY ASSURANCE PROGRAM

10 pieces inspected at Revision "E" at Phila. aval [illegible].

9 pieces not acceptable as follows:

Piece #1

a. 3-1/4-6 UNS-2 left hand threads and adjoining surfaces contain a heav deposit of rust; also contains a 1/8" inspection hole on the 30° angl surface.

Pieces #2 to #8

a. Contain a 1/8" inspection hole on the 30° angle surface. Hole is not shown on drawing.

Piece #9

a. Contains a 1/8" inspection hole as above but with a broken drill.

NOTE: 1. "Hold, Do Not Issue" tag #9, was attached to material.
2. Material is currently located in bldg. 83. It was off-loaded fro USS SHANGRI-LA (CVA-38).
3. Unit Price - $45.

/s/ V. COLUMELLA - Ext. 3240

ENGINEERING COMMENT	PC#1 WILL BE ACCEPTABLE IF [illegible] IS REM
APPROVED	PC#2 [illegible]
DISAPPROVED	PC#9 WILL BE ACCEPTABLE IF [illegible]

APP. F-12

NAVD-NAEC-2455(REV. 2-68)

PLATE NO. 51902

400790-10

NAME SOCKET-EYE END (3)

FSN RM1710-315-9631 ECRG

SUPERSEDES

SUPERSEDED BY

CAT. DECK GEAR & ACC. SER. BULL.

CAT. DECK GEAR & ACC. SER. CHG.

SERVICE BULLETIN

SERVICE CHANGE MK 7 MOD 0

DESIGN CHANGE

REPAIR PROCEDURE

E.O. 57-222

BIR

DATE 12 January 57

COMPONENT OF 21-60158 FOR 6

21-60263 FOR

FOR

FOR

APPLICABILITY CHAR	MK-2	MK 4	NOSE GEAR TOW			
	MK-5 MOD 1	MK-5 MOD 3	MK-7 MOD 1	MK-7 MOD 2	NOREST	E-2	E14-1
			X				

NSL	✓	SOURCE CODE
QUANTITY PER ASSEMBLY	1	UNIT PRICE
QUANTITY PER CATAPULT		REPAIRABLE
QUANTITY PER ARRESTING GEAR		SHELF LIFE
WEIGHT	12.0	P.A.M.D.S. AC
CUBE		

NOTE: (1) Fitted Dwg. 3.1918 For use in Drawing Number 400790 in Assy's 6 & 7. (2) For Fed. Stock Catalog Cataloging Data 07056, 07097, 07112, CUAG3, 63, 65.

ENGR. DATA RECORD CARD BRASO FORM 17 (5-63) (FORMERLY BND - NAVC - 6302) (OV

PACKING & PRESERVATION DATA

Clean all unplated surfaces in accordance with Process C-1 of SPEC. MIL-P-11 all unplated surfaces with cprrosion preventive compound Spec. MIL-C-16173C, Individually wrap in grease proof barrier material Spec. MIL-B-121, Grade "A Class 2. Pack in a nailed wood box, ~~S/S~~ Spec. FED. PPP-B-621, Class 1, (Yo Group one wood, designed with skids on bottom and battens on top. Skids and full width of box and have ends squared. Construction is to provide for a s non shifting load. Weight of container and contents to be limited to appro each. Item identification is to be in accordance with Method "A" of BRASO M of 18 Jan. 1957. Contract number is to be ~~used~~ added to item identification

REVISIONS		
1		INC. 1021/1
2		BRASO FORM 17 (BACK)
3		
4		
5		

SI) SCHEDULE 47494	NAEL (SI) #66-6021	DATE 16 Feb 1966
	DRAWING/PART NO. AFFECTED: 71-40212-2	TITLE: Spacer, Inner (Steel) FSN 4RM1710-316-0033

QUALITY ASSURANCE PROGRAM

ces inspected to Revision "G" at San Francisco Naval Shipyard.

ces not accpetable as follows:

. 20 pieces are rusty due to improper packaging and preservative.

. 20 pieces are in first stages of rusting.

. The 20 pieces are rusted on face areas.

1. "Hold, Do Not Issue" tag #13, dated 7 Feb 1966, was placed on material.
2. This material is currently located at Islias Creek, Bldg. 427, off load of USS CORAL SEA (CVA-43).
3. Unit Price - $6.
4. Revision of drawing to which material was manufactured is unknown.

/s/ John Brancu - Ext. 3722

ef: 261842Z of 26 Jan 1966

IEERING COMMENT

NOT ACCEPTABLE UNLESS RUST IS REMOVE-

WE

V. BELFANTI

Part No. 71-40212-2

Name	SPACER Inner (Steel)
FSN	5340 1710-316-0033
Supersedes	
Superseded by	
Arresting Gear Repair Proc	
Cat Repair Procedure	
Cat Deck Gear & Acc Ser Bull	
Cat Deck Gear & Acc Ser Chg	
Cat Deck Gear & Acc Des Chg	
Service Bulletin	
Service Change	
Design Change	
E.O.	
EIR	Date [illegible] March 1970
Component of	61[illegible]-1 for 612571 · 7[illegible]-6646
	666697-1 for 7[illegible]-53[illegible]-1 · 5[illegible]205
	[illegible]-1 for 7[illegible]-765-1 · 612581 etc.

Applicability Chart

M-R	811-1	C-7	C-13	C-13-1	CE1-3	Dead Load	MK-2
MK-5 MOD-3	MK-7 MOD-1	MK 7 MOD 2	MK-7 MOD 3	M-2 Mores	M-21	E-5 E 5-1	E14
	X	X	X				
E-28							

ICL Qty per Equipment/Vessel

Quantity per Assembly	2	Source Code	
Quantity per Catapult		Unit Price	[illegible]
Quantity per Arresting Gear		Repairable	
Weight	4.	Shelf Life	
Cube	.01	F.A.R.D.C. Action	

Notes
[illegible]-1
[illegible] dated 13 September 1966 [illegible]

Engr. Data Record Card BRASO Form 17 (Rev 3-65) Formerly 4ND-NANC-6302

PACKING & PRESERVATION DATA

[illegible] packaging shall be level "A" as follows: Clean in accordance with [illegible] MIL-P-116. Preserve with corrosion preventive compound Spec MIL-C-[illegible] [illegible] individually in accordance with [illegible] 1A-8 of Spec MIL-P-116. [illegible] shall be Level "B" [illegible] level "A" [illegible]: Pack in a nailed wood box Spec Fed PPP-B-621, Class [illegible] [illegible] with skids on bottom and battens on top. Skids and battens [illegible] ends covered. Box construction to provide for [illegible] NAEC Part Number, Federal Stock Number and Contract Number to be [illegible] packages.

1	[illegible] PR 15391	1530 [illegible]
2	[illegible] PR 290111	
3	[illegible] PR [illegible]	
4	[illegible] PR 53115	
5	[illegible] PR 680/70 [illegible]-70	

APP. F-14

CONTRACTOR'S NAME	CONTRACT NO'S NUMBER	DATE
156-41105 BRISTOL DYNAMICS	NAEL (SI) #66-6014	27 Jan

ITEM	DRAWING/PART NO. AFFECTED	TITLE
MK-7	317434-1	Clevis Pin FSN 5306-805-3394

QUALITY ASSURANCE PROGRAM

27 pieces inspected to Revision "C".

27 pieces not acceptable as follows:

a. 27 pieces not preserved.

b. 27 pieces rusty over entire part.

NOTE: 1. "Hold, Do Not Issue" tag #7, dated 18 Jan 1966, was placed on mate
2. Unit Price - $6.40
3. Recommend cleaning rust from pieces and preserve as per spec.
4. Warranty has expired.

/s/ O. DI DOMENICO - Ext. 3722
/s/ J. BRANCU - Ext. 3722

TF-6 Ref: Ø521482 of 5 Jan 1966

L ENGINEERING COMMENT

CONCUR WITH RECOMMENDATION.

APPROVED

DISAPPROVED

H Keno

SIGNED F.J. TROTTA (NE721) 2/18/66 APPROVED

317434-1

NOZ

SET

SPECIFICATIONS

SUPERSEDED BY

ARRESTING GEAR REPAIR PROC.

AT. REPAIR PROCEDURE

AT. ROCK GEAR & ACC. SER. NUL.

AT. ROCK GEAR & ACC. SER. CHG.

AT. ROCK GEAR & ACC. MOD. CHG.

SERVICE BULLETIN

SERVICE CHANGE

DESIGN CHANGE

NO.

DR. DATE

DEPOINT OF FOR

FOR

FOR

APPLICABILITY CHART								
E-8	C11-1	C-7	C11-2	C-13	C13-1	TC13		
MK-2	MK 4	[illegible]						
MOD 3	MOD 3	MOD 2	CREST	E-5	E14-1	E14-1A		
	✓	✓				✓		

NSL 11-17-66	✓	SOURCE CODE
QUANTITY PER ASSEMBLY	1	UNIT PRICE
QUANTITY PER CATAPULT		REPAIRABLE
QUANTITY PER ARRESTING GEAR	1	SHELF LIFE
WEIGHT	4.1	P.A.M.D.S. ACTIO
CUBE	.02	

NOTES

9-18-68 Cig. #1 thru 92 Incl. Incorp.

ACR. DATA RECORD CARD BRASO FORM 17 (6-64 Rev.) (FORMERLY 4 ND-NAEC - 6302)

PACKING & PRESERVATION DATA

IN ACCORDANCE WITH . PROCESS C-1 OF SPEC. MIL-P-116E. PRESERVE WITH CORRO
COMPOUND, SPEC. MIL-C-16173D, GRADE 2. PACKAGE INDIVIDUALLY in accordan
thod 1C-2 of Spec. MIL-P-116E. Pack in a Fib
trainer, Spec Fed. PPP-R-636, Type C.F. or S.F. C
mestic 1 Overseas Weather Resistant as required
S.C. designed to provide for a compact non-sta
A.E.C. Part Number, F.S.N. and Contract Numb
inted on the unit packages.

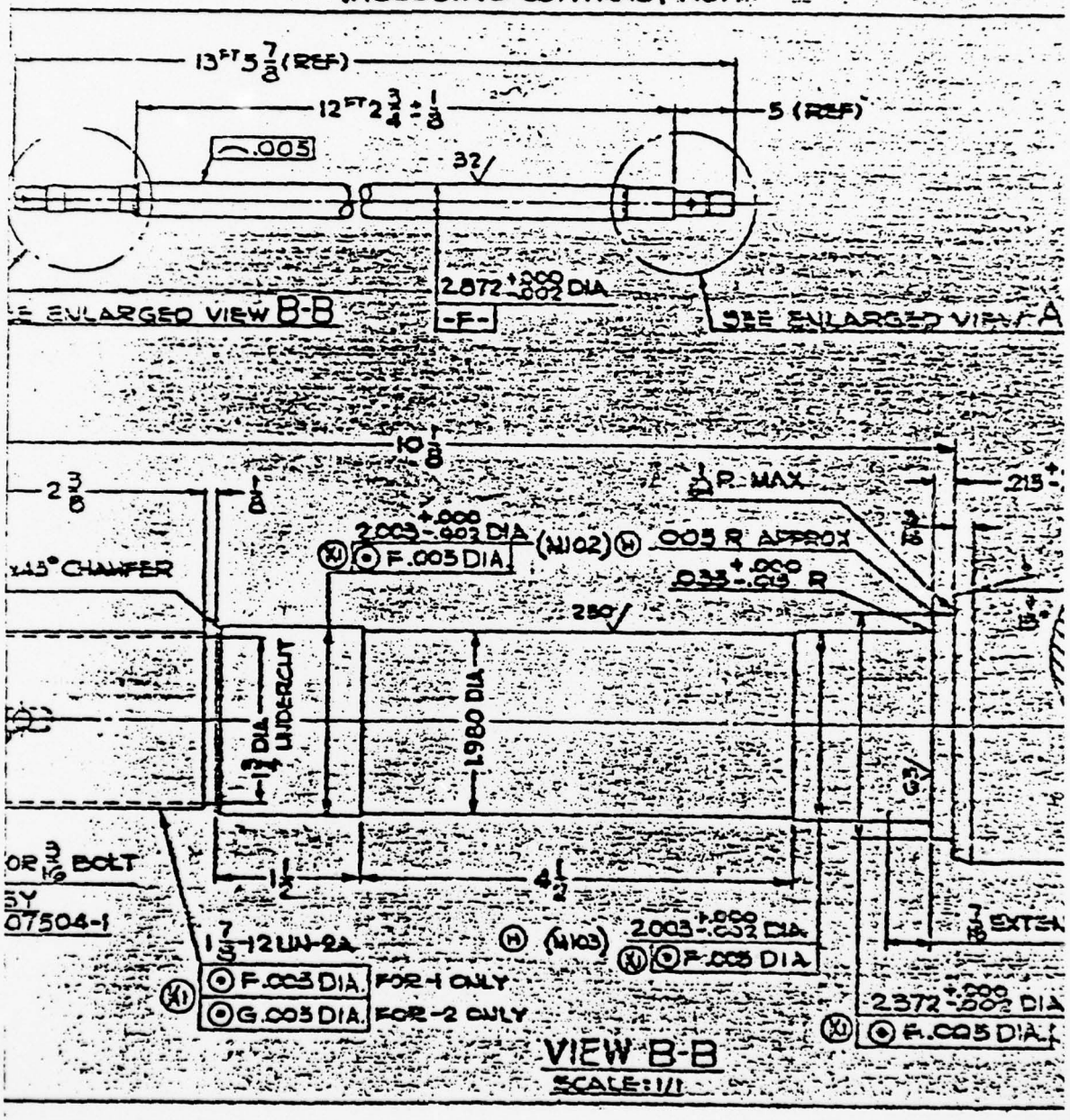
Incl 1 Sht
Incl PR 495
Chng 1, 9c Cig

D FORM 17 (BACK)

APP. F-15

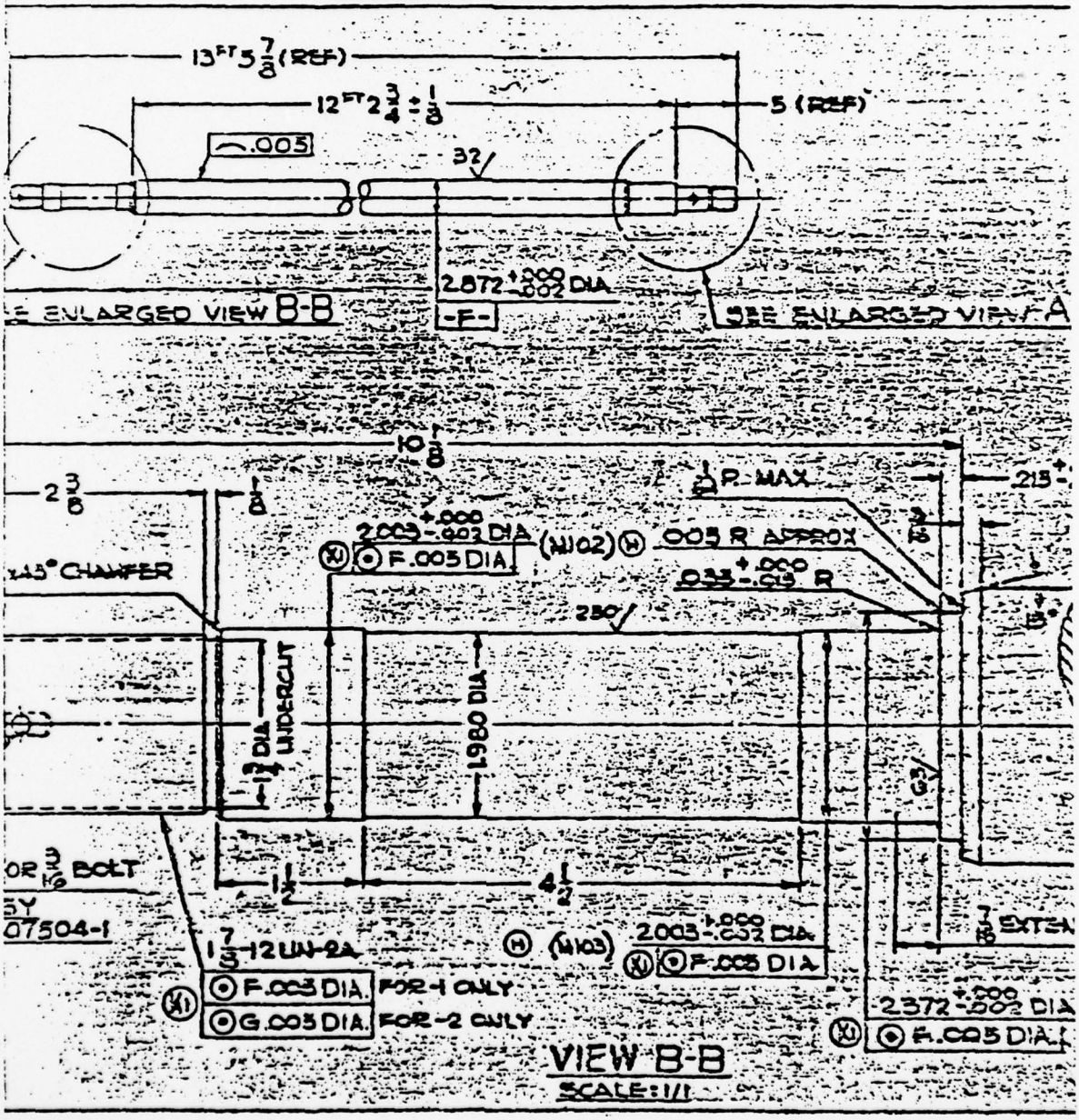
REF: PHOTO - F/N 50130-1, FSN SPN 1710-717-6915 (U.S.S. CORAL SEA FEB '66)

(13) DOCK SIZE AND WEIGHT IS NOMINAL WITHOUT ALLOWANCE FOR NAEC USE ONLY.
(12)(14)10 PISTON ROD SHALL BE IDENTIFIED IN ACCORDANCE W INCLUDING CONTRACT NO.



REF. DWG. 504130-1

(U) 3 DIOCK SIZE AND WEIGHT IS NOMINAL WITHOUT M
ALLOWANCE FOR NAEC USE ONLY.
(L2)(M)10 PISTON ROD SHALL BE IDENTIFIED IN ACCORDANCE W
INCLUDING CONTRACT NO.



REF. DWG. 504130-1

CONTRACT'S NAME		CONTRACTOR'S NUMBER	DATE
6-36975 REL-BIRMINGHAM		NAEL (SI) #65-6093	1 Dec
ITEM	DRAWING/PART NO. AFFECTED	TITLE	
7	504047-1	Cap Assembly	FSN 1710-771-1284

QUALITY ASSURANCE PROGRAM

Pieces inspected to Revision "H" at OAK.

Pieces not acceptable as follows:

Piece #1

a. 7-7/8" diameter x 1/32 deep c'bore has not been incorporated.
b. Surface finish in 9.502 bore appears to have been reworked by hand. Th result is an uneven surface.
c. $2.500^{+.002}_{-.000}$ diameter bore is 2.505.
d. 63 finish on spotface around all ports is painted.
e. 63 surface finishes on 5" diameter bosses are painted.
f. 6" diameter square x 1/2" deep boss has not been incorporated. NOTE: boss were to be incorporated, the depth of the 1-5/8-8 holes will be undersize.)
g. Surface finish on extreme end of cap is approximately 125 to 150 in lie 63 required. This surface is also painted.

Piece #2

a. 7-7/8" diameter x 1/32" deep c'bore has not been incorporated.
b. Sixteen 3/4-10 tapped holes will not accept "go" gage to required depth
c. Deep scratches in 9.502 diameter bore.
d. 63 finish on spotface around all ports in painted.
e. 63 finish on 5 diameter bosses is extremely rusty.
f. $2.500^{+.002}_{-.000}$ diameter bore is 2.507.
g. 6" diameter square x 1/2 deep boss has not been incorporated.

ENGINEERING COMMENT

PIECES ARE NOT ACCEPTABLE.

APPROVED

DISAPPROVED

AD-A054 914 NAVAL AIR ENGINEERING CENTER LAKEHURST N J ENGINEERIN--ETC F/G 1/5
PRESERVATION AND PACKAGING OF LAUNCHER AND RECOVERY SYSTEMS COM--ETC(U)
MAY 78 D BEHMKE, E CAHALL

UNCLASSIFIED NAEC-ENG-7818 NL

3 OF 3

AD A054914

END

DATE FILMED

7-78

DDC

NAVAIR-2455(REV. 2-68)

PLATE NO. 11962

APP. F-16

RSA NAEL (SI) #65-6093

Sheet 2 of 2 She

h. 1-5/8-8-3B holes (2 places) have not been incorporated.
i. Rust and paint in 3.503 diameter c'bore.
j. Surface finish on extreme end of cap is approximately 125 to 150 in This surface is also painted.

NOTE: 1. Pieces have been identified as #1 and #2.
2. "Hold, Do Not Issue" tag #25, dated 11-10-65, was attached to mat
3. Unit Price - $695.
4. Material returned to BRASO stock from USS TICONDEROGA off-loaded s

/s/ E. SCHARNAGL - Ext. 3722
/s/ F. BELFUS - Ext. 3722

F-6 Ref: 272054Z of 27 Oct 1965

SURFACES - RUST & PITTED

REF: PHOTO -

P/N 5040471-1, FSN 1710-771-1284 (U.S.S. CORAL SEA FEB'66)

NAVAER-2455(REV. 2-68)
PLATE NO. 11962

APP. F-16

504047-1
NAME CAP ASSY
FSN 4 KM1710-771-128C ~~CSD~~
1 SUPERSEDES
SUPERSEDED BY
CAT. DECK GEAR & ACC. SER. BULL.
CAT. DECK GEAR & ACC. SER. CHG.
SERVICE BULLETIN
SERVICE CHANGE MK 7 MOD 165
MK 7 #253
DESIGN CHANGE
REPAIR PROCEDURE
E. O.
DIR
DATE 7-23-59
COMPONENT OF FOR
607952-1
6107-83 Kit mod Cyl Assy MK 7 MOD 3
6107-82-1 Cyl. Ass'y FOR
FOR

APPLICABILITY CHART

MK-2	MK 4	NOSE GEAR TOW				
MK-5 MOD 1	MK-5 MOD 3	MK-7 MOD 3	MK-7 MOD 2	MOREST	E-5	E1 4-1
		X	X			

NSL 9-27-66	L	SOURCE CODE
QUANTITY PER ASSEMBLY	1	UNIT PRICE
QUANTITY PER CATAPULT		REPAIRABLE
QUANTITY PER ARRESTING GEAR	2	SHELF LIFE
WEIGHT	322.6	P.A.M.D.S. A
CUBE	1.3	

NOTES: Cyl. Assy Drawing 22 Index No. for MK 7 C
To Convert Rev. C to D Change
and Continue Item Spec. 35 Rec. Qty
Rec'd in and Stock Should Inventory
Complete in Detail Subject to C
Above Drawings Rev. Ltr.

ENGR. DATA RECORD CARD BRASO FORM 17 (5-63) (FORMERLY NAD - NAMC - 6307)
ADT NAMEPLATE TO MAIN RAMS STROKE ADJUSTER, PER E. LAWS, DWG. ENG

PACKING & PRESERVATION DATA

CLEAN IN ACCORDANCE WITH PROCESS C-5 OF SPEC. MIL-P-116E. PRESERVE WITH
PREVENTIVE COMPOUND SPEC. MIL-C-16173C, GRADE 2. INDIVIDUALLY WRAP IN GREASE
BARRIER MATERIAL SPEC. MIL-B-121, GRADE A, TYPE 2, CLASS 2. SECU
WITH PRESSURE SENSITIVE TAPE. PACK ONE EACH IN A NAILED WOOD BOX, SPEC. FED.
CLASS 1 & GROUP ONE WOOD, DESIGNED WITH SKIDS ON BOTTOM AND BATTENS ON TOP. S
BATTENS ARE TO RUN FULL WIDTH OF BOX AND HAVE ENDS SQUARED. CONSTRUCTION OF
SAFE COMPACT, NON SHIFTING LOAD. ITEM IDENTIFICATION:

NAEL part number F
Contract number to be metal stamped on 12" flat

REQUISITION
1
2
3
4
5

BRASO FORM 17 (BACK)

Part No. 504821-1 400

Name STRAP ASSY (400 FC)

FSN 1720-830-3229

Supersedes VER-B1-1164

Superseded by

Arresting Gear Repair Proc.

Cat Repair Procedure 9 *

Cat Deck Gear & Acc Ser Bull

Cat Deck Gear & Acc Ser Chg

Cat Deck Gear & Acc Des Chg #31 #32

Service Bulletin

Service Change

Design Change

E.O. 2-1180; 64-621; 65-67; 66-782

IR Date 13Feb67

Component of for

60564 for

60630 for

Applicability Chart

H-8	C11-1	C-7	C-13	C-13-1	CE1-3	Dead Load	MK-
	X	X	X				X

MK-5 MOD-3	MK-7 MOD-1	MK-7 MOD 2	MK-7 MOD 3	M-2 Morest	M-21	E-5 E 5-1	E1
E-28							

Quantity per Assembly	1	Source Code	
Quantity per Catapult	1	Unit Price	
Quantity per Arresting Gear		Repairable	NO
Weight	198.3	Shelf Life	
Cube	2.7	P.A.M.D.S. Actio	

Notes MPR1028 was furnished for comp in lieu of sole source MPR 1028 per Rev "H" of NAEL Dwg 5048

Engr. Data Record Card BRASO Form 17 (Rev 3 [illegible] (Cover)

Packing and Preservation Data

Cleaning disinfection, packaging and packing shall be Level "A" in accordance with MPR 1283. [redacted] Part Number, Federal Stock Number, Number and date of preservation to be stenciled on shipp...

1 Two (2) may be used on Dr. 3 (013-1) C-7 aft per (VA 67)

1	100 cm	PR 617/67	1 / 1
2	100 cm	PR 834/69	5/16/69
3	50 cm	PR 603/71	5/18/71
4	150 cm	PR 886/72	4-10-72
5	750 cm	PR 2065-2074	9-14-72

Part No. 504821-3 460' MK 4 Mo.

Name Strap, Assembly

FSN 5340-720-961-6451

Superseded by

Arresting Gear Repair Proc

Cat Repair Procedure #9

Cat Deck Gear & Acc Ser Bull

Cat Deck Gear & Acc Ser Chg

Cat Deck Gear & Acc Des Chg

Service Bulletin

Service Change

Design Change 1382

E.O. 64-621

MR

Date 9 May 1968

Component of Bridle Arresting Gear for CVA 67 Unit for CVA 66 #3 cat for CVA 67 CVAN 68

Engr. Data Record Card LAKEHURST BRAND FORM 17 (Rev 3-65) Formerly NAVAIR-NAEC-6302

Applicability Chart

M-A	C11-1	C-7	C-13	C-13-1	C21-3	Load Load	MK
				X			
MK-5 MOD-3	MK-7 MOD-1	MK-7 MOD 2	MK-7 MOD 3	MK-2 Mores	M-21	E-5 E 5-1	E1
L-28							

IOL Qty per Equipment/Vessel

Quantity per Assembly	1	Source Code	
Quantity per Catapult	1	Unit Price	7-12-
Quantity per Arresting Gear		Repairable	
Weight	228	Shelf Life	
Cube	2.7	P.A.M.D.S. Actio	

4-1-69 Per Ross Engr. "Only -3 strap on CVA67 is subject to wear. -1 strap in addition to -3 (C13-1) Correct."

PACKING & PRESERVATION DATA

Packing, preservation, packaging and packing shall be Level "A" in accordance with NAR 1252. Part Number, Federal Stock Number, Contract Number and date of preservation to be stenciled on shipping boxes.

75 ea. AR 769/65

10 ea. AR 351/70

20 ea. AR 647/70

50 ea P.R 663/71 5/18/71

20 ea P.R 884-172 4/21/72

502 ea. PR-2365-2044 9/6/71

MATERIAL AND PROCESS REQUIREMENTS

NAVAL AIR ENGINEERING LABORATORY (SHIP INSTALLATIONS)

NAVAL AIR ENGINEERING CENTER — PHILADELPHIA, PA. 19112

MPR 1283

DATE

TITLE: Preservation, Packing and Packaging of Mark 2 and Mark 4 Bridle Arrester Straps

SHEET 1 OF

Scope:

1. This MPR pertains to the procedure for preserving, packing and packaging of Mark 2 and Mark 4 Bridle Arrester Straps. Mark 2, Mod 0 and Mod 2, P/N 50-6221-2 Strap, P/N 50-6221-1 strap assembly, Mark 4 Mod 1 and Mod 2 P/N 50-6214-4 strap, P/N 50-6214-3 strap assembly.

Requirements:

2. Cleaning: Cleaning as detailed below shall be conducted after all manufacturing operations, including heat treatment, have been performed on each strap assembly. Each strap assembly shall be thoroughly cleaned using solvent per Spec. TT-T-291 Grade 1 and wiped dry. Fingerprint remover per Spec. MIL-C-15074 shall then be thoroughly applied to the strap and the strap shall again be wiped dry. During and after application of fingerprint remover, the strap shall be handled with care so as not to contaminate the surface of the strap.

Preservation:

3. The strap shall be preserved by thoroughly coating with grease per Spec. MIL-G-23827.

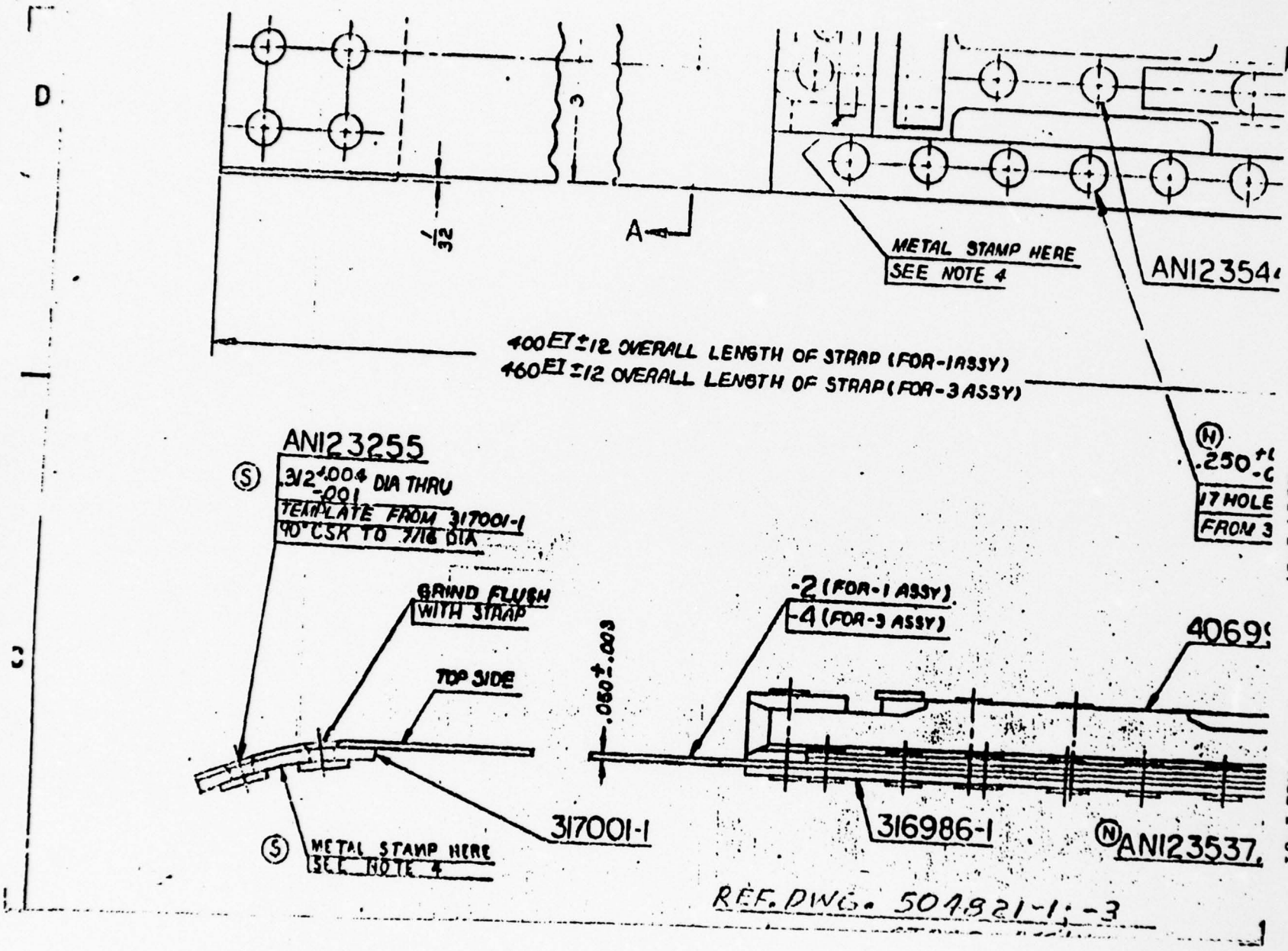
Packing:

4. The strap shall be wound on a commercial wooden reel. The outside diameter of the strap shall be completely wrapped with barrier material per Spec. MIL-B-121 Type I Grade A Class 1. The outside diameter of the reel shall then be covered with wood segments. The reel shall then be placed into a barrier bag per Spec. MIL-B-131 Class 1. Desiccant bags per Spec. MIL-D-3464 shall be placed in the barrier bag. The bag shall then be evacuated and heat sealed.

Packaging:

5. The taped reel shall be packaged in a wooden box per Spec. PPP-B-621 Class 2 Group 1. Extreme care shall be exercised in handling and positioning the taped reel in the box in order to avoid rupture and/or chafing of the bag during shipment. The box shall contain skids on the bottom and battens on top and be so constructed to provide for a compact non-shifting load. The skids and battens shall run the full width of the box and have the ends squared. The outside of the shipping container shall be stenciled as follows: "DO NOT UNPACK THE CONTENTS OF THIS CONTAINER PRIOR TO SERVICE USE."

THESE REQUIREMENTS ARE ONLY APPLICABLE WHEN REFERENCED ON A CONTRACT OR PURCHASE ORDER


D
C
3
1/32
A
METAL STAMP HERE
SEE NOTE 4
AN12354
400 ET ±12 OVERALL LENGTH OF STRAP (FOR-1 ASSY)
460 ET ±12 OVERALL LENGTH OF STRAP (FOR-3 ASSY)
AN123255
Ⓢ .312 +.004 -.001 DIA THRU
TEMPLATE FROM 317001-1
90° CSK TO 7/16 DIA
GRIND FLUSH WITH STRAP
TOP SIDE
Ⓢ METAL STAMP HERE SEE NOTE 4
317001-1
.050 ±.003
-2 (FOR-1 ASSY)
-4 (FOR-3 ASSY)
316986-1
Ⓝ AN123537
Ⓝ .250
17 HOLE
FROM 3
4069
REF. DWG. 501821-1, -3

APP. F-18

Part No. 509979-1

Name Valve

FSN 5841-720-917-6377

Superseded

Superseded by

Arresting Gear Repair Proc

Cat Repair Procedure

Cat Deck Gear & Acc Ser Bull

Cat Deck Gear & Acc Ser Chg

Cat Deck Gear & Acc Des Chg

Service Bulletin

Service Change C7E-241, C11-1 #262, C13 #140 C13-1 #56

Design Change

E.O.

BIR | Date 1-4

Component of 615178 for CVA41
612276 for CVA67
616777 for CVA 68 CF

Applicability Chart

M-8	C11-1	C-7	C-13	C-13-1	TC-13	Drag Load	MK-2
	X	X	X	X			
	1 ea	1 ea	1 ea	1 ea			
MK-5 MOD-3	MK-7 MOD-1	MK-7 MOD 2	MK-7 MOD 3	M-2 Morest	M-21	E-5 E 5-1	E14-1

Quantity per Assembly		1	Source Code
Quantity per Catapult		2	Unit Price
Quantity per Arresting Gear			Repairable
Weight	Est	30.	Shelf Life
Cube		.3	P.A.M.D.S. Action

Notes [illegible] SK 6-
CVA 68 CAS 8

Engr. Data Record Card BRASO Form 17 (Rev 3-65) Formerly 4ND-NAMC-6302 (s
615301 FOR CVA 68

Packing and Preservation Data

Cleaning, preservation, unit packaging, packing and marking identification requirements to be in accordance w/ Level "A" MIL-STD-794A (ASG).

1	TS ea TDR 7-2/66 5-14-69
2	
3	
4	
5	

BRASO Form 17 (back)

NAEC ENGINEERING INFORMATION ON
FITTINGS DESIGNED FOR USE WITH
THIS VALVE ARE SHOWN ON
DRAWING
A12
F
RETURN PORT
SEE NOTE 4
3/16-12UNS-3A
3 PORTS
1A .005 TIR
(M102)
2 7/16
17
PRESSURE PORT
E1
SURFACE
16 00

613101-7

Name Piston Assembly
FSN 4720-225-2647
Supersedes 613101-5
Superseded by 613102-11 (INTERCHANGEABLE)
Arresting Gear Repair Proc
Cat Repair Procedure
Cat Deck Gear & Acc Ser Bull
Cat Deck Gear & Acc Ser Chg
Cat Deck Gear & Acc Des Chg
Service Bulletin
Service Change CVE 321, CV-1 #355 C13 #234, C131 #145
Design Change
E.O.
BIA Date 7-6-70
Component of for
for
for

Applicability Chart

M-R	C11-1	C-7	C-13	C-13-1	CE1-3	Blag Load	MK-2
	X	X					
MK-MOD-3	MK-MOD-1	MK MOD 3	MK-MOD	M-2 Mores	M-21	E-5 E 5-1	E11-
E-28						✓	

IOL Qty per Equipment/Vessel

Quantity per Assembly		Source Code	
Quantity per Catapult	1	Unit Price	
Quantity per Arresting Gear		Repairable	
Weight		Shelf Life	
Cube		P.A.M.D.C. Action	

Notes * PHONE 4-14-71 CMR. TRANSMITTED

Engr. Data Record Card BRASO Form 17 (Rev 3-65) Formerly NAVAIR-NAEC-6302

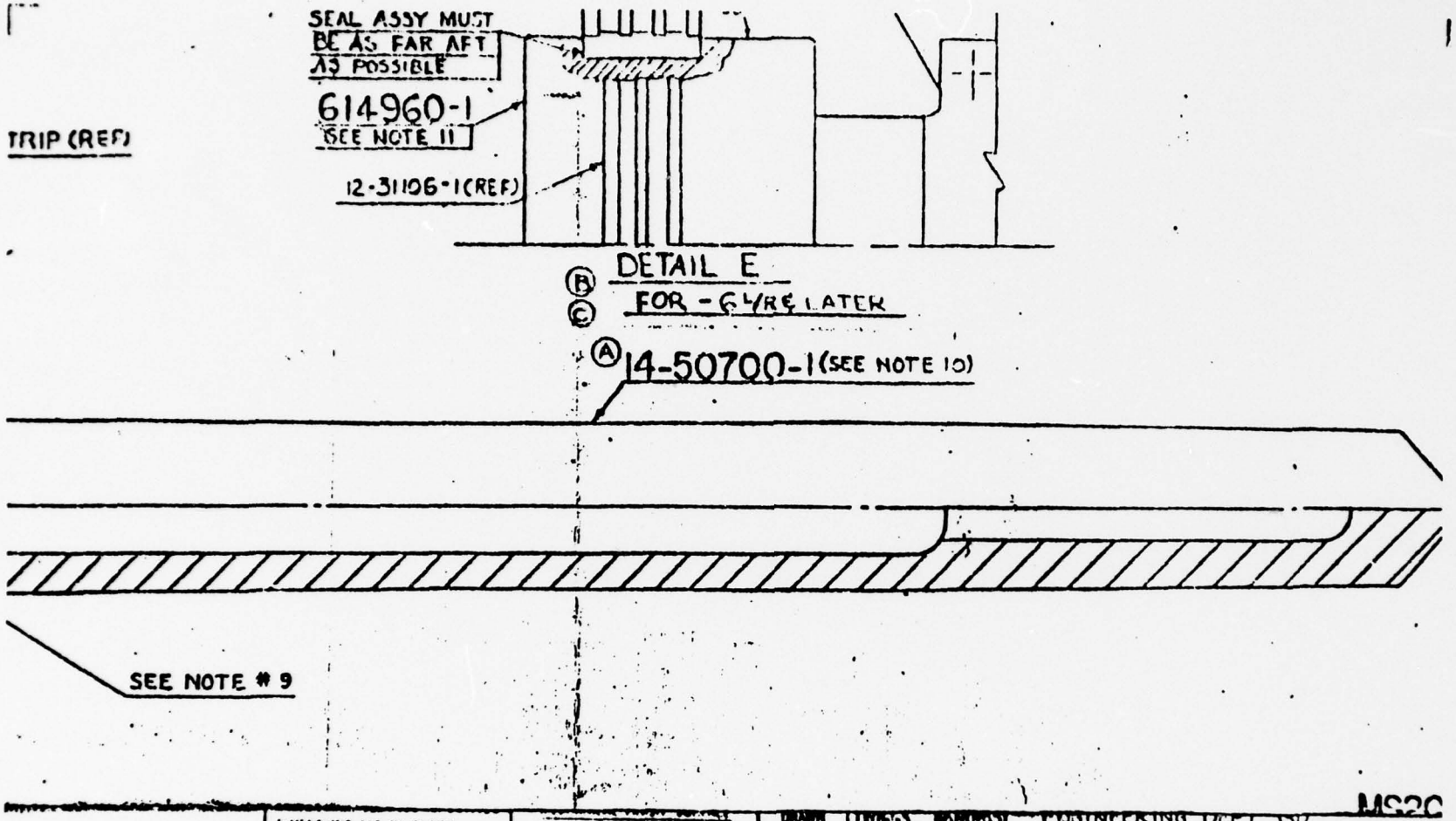
Packing and Preservation Data

Clean all unpainted/unplated steel surfaces finished 125 or finer in accordan
process C-5 of Spec. MIL-P-116E. Clean all other surfaces in accordance with F
Preserve all unpainted/unplated steel surfaces with corrosion preventive compou
MIL-C-16173C, Grade 2. Wrap preserved surfaces with greaseproof barrier mat
MIL-B-121 Grade A, Type 2, securely attached with pressure sensitive tape.
Pack complete assembly consisting of one each 613101-2L and 613101-2R PISTON AS
nailed wood sheathed crate, Spec. MIL-C-104, type 1, Class 1 Or 2, Style A.
Assembly to be secured within shipping crate by adequate blocking, bracing or c
surfaces of Piston Assembly having contact with blocking, bracing or cradling s
ded, using cellulose cushioning material wrapped in greaseproof barrier mater
Spec. MIL-B-121, Grade A, type 2, Class 2. Construction of Crate shall provide

Requisition

1	safe, non shifting load. Item Iden
2	Federal Stock Number to be added
3	identification requirements shown on dr
4	* 613101-1 can be modified by [illegible]
5	[illegible]

BRASO Form 17 (back)



MS2C

DIMENSIONS ARE IN INCHES
TOLERANCES ON
FRACTIONS — DECIMALS .010 ANGLES ±1°

ROUGHNESS IN MICROINCHES
✓ THIS SYMBOL EMBRACING THE SURFACE ROUGHNESS (IN MICRO-INCHES) REPRESENTS THE MAXIMUM ACCEPTABLE ROUGHNESS, AND MAY BE PRODUCED BY ANY MECHANICAL PROCESS
REF MIL STD 10

DRAWN	[illegible] E.S. ENARD	[illegible] 11 MAR 66
CHECKED	D.J. NOLMAN	
MATERIAL	—	—
ANALYZED	—	—
SUPERVISOR		
APPROVED	DATE	

ENGINEERING DEPT (SF)
NAVAL AIR ENGINEERING CENTER, PHILA., PA. 19112

TITLE
PISTON ASSEMBLY
LAUNCHING ENGINE
LONG GUIDE

CODE IDENT NO. 80063 | SIZE II | DRAWING NO 613101

Part No. 613102-13 C13 only

Name	Port Cable
FSN	4914 1730-225-2675 ⊗
Supersedes	
Superseded by	
Arresting Gear Repair Proc.	
Cat Repair Procedure	
Cat Deck Gear & Acc Ser Bull.	
Cat Deck Gear & Acc Ser Chg.	
Cat Deck Gear & Acc Des. Chg.	
Service Bulletin	
Service Change	
Design Change	
E.O.	
BIR	Date
Component of	for
Tracking Engine	for
	for

Applicability Chart

E-8	C11-1	C-7	C-13	C-13-1	CE1-3	DEAD LOAD
			X	X		
MK 5 MOD-3	MK 7 MOD-1	MK 7 MOD-2	MK-7 MOD-3	M-2 Aprest	M-21	E-5 E 5-1
E-28					✓	

ICL Quantity per Equipment/Vessel		
Quantity per Assembly		Source Code
Quantity per Catapult	1	Unit Price $
Quantity per Arresting Gear		Repairable
Weight		Shelf Life
Cube		P.A.M.D. S. Ac

Notes: * Identification Tag 1-11
Contains C13 Connector 505C20-3
1 Interchangeable Connector 511307
Drawing 12-0G141-3 4/R inc. Sheet 2
Drawing 613602-1 4/R

ENGR. DATA RECORD CARD — BRASO FORM 17 (REV. 6-70) Formerly 4WD-NAEC-6302

PACKING & PRESERVATION DATA

Preservation-packaging shall be level "A" as follows. Clean all unpainted surfaces in accordance with Spec. MIL-P-116E. Use Process C-5 for surfaces than 125 micro-inch and Process C-1 for all other surfaces. Preserve unplated ferrous surfaces with corrosion preventive compound Spec Grade 2. Wrap preserved surfaces with grease-proofed barrier mat PPP-B-121, Grade A, Type II, Class 2 secured, attached with waterline tape in accordance with Method I of Spec. MIL-P-116E. P packaged as above shall be packed Level "B" as follows: Pack one (1) each item assembly Cable Set in a nailed wood sheathed crate Spec. MIL-C- or Class 2, Style B. Fiber Assembly to be secured, blocked and brace within the crate to provide a compact non-shifting load. Surfaces com with blocking and bracing or cradle to be protected with cellulosic cushion

1	wrapped in grease-proofed barrier material Spec. PPP-B-121 Grade A.
2	Marking to be keyed to the identification requirements of Drawing
3	See Sht. 1 Item 11.4 Note
4	
5	

BRASO FORM 17 (BACK)

Part No. 613380-2 272 Gen'l P/N. GN615

Name Sealing Strip

FSN [illegible]

Supersedes 11-31030-2 *

Superseded by

Arresting Gear Repair Proc

Cat Repair Procedure

Cat Deck Gear & Acc Ser Bull

Cat Deck Gear & Acc Ser Chg

Cat Deck Gear & Acc Des Chg

Service Bulletin

Service Change

Design Change

E.O.

B!R Date 9 Feb-66

Component of Launching Engines for

for

for

Applicability Chart

H-8	C11-1	C-7	C-13	C-13-1	CE1-3	Dead Load	MK-2
	X	X	X				
MK-5 MOD-3	MK-7 MOD-1	MK-7 MOD 2	MK-7 MOD 3	M-2 Morest	M-21	E-5 E-5-1	E14-1

Quantity per Assembly			Source Code
Quantity per Catapult		2	Unit Price
Quantity per Arresting Gear			Repairable
Weight		454.	Shelf Life
Cube		99.	P.A.M.D.S. Action

Notes * Issue 11-31030-2 until exhausted prior to 613350-2

Engr. Data Record Card BRASO Form 17 (Rev 3-65) Formerly 4ND-NAMC-6302 (s

Packing and Preservation Data

[illegible]

DRAWING NO 613380 NOTES.

1 [illegible]
2
3
4
5

BRASO Form 17 (back)

(NO-NAEC-2455(REV. 2-68)
PLATE NO. 11968

APP. F-21

Memorandum

B32:RFE
DATE: 25 SEPT

FROM : BRASO (C&AG) B32

TO : AS-724

SUBJECT : PRESERVATION AND PACKAGING INSTRUCTIONS, REVISIONS TO

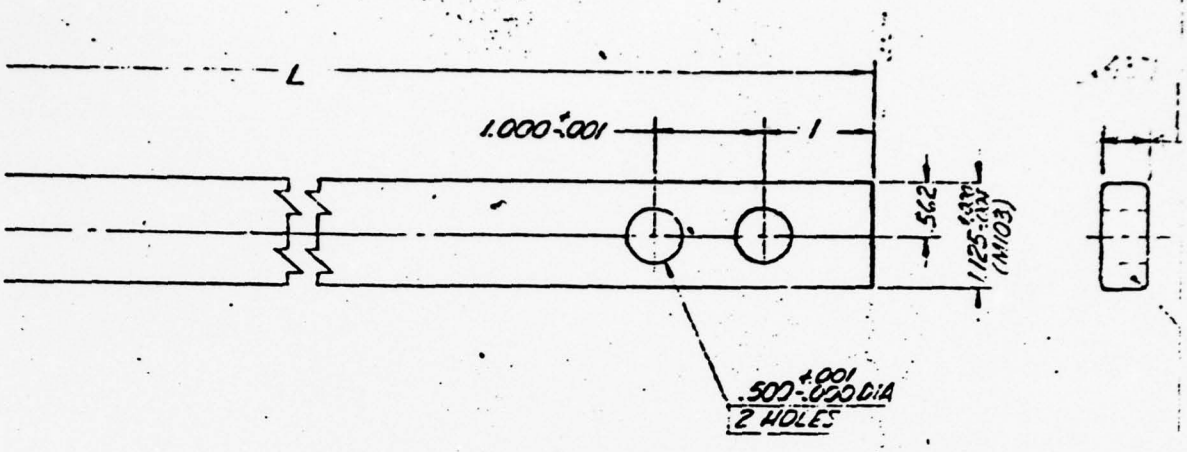
WHEN CONTRACT IS NEGOTIATED ON BRASO P.R. 201/69, PART NUMBERS 613380-2 AND 613380-3, THE FOLLOWING CHANGES SHOULD BE IN INCORPORATED ON TH PRESERVATION AND PACKAGING INSTRUCTIONS DELINIATED ON THE APPLICABLE DRAWING AS FOLLOWS:

1. NOTE 9, II, PARA. (2); CHANGE PRESENTLY SPECIFIED CONFORM WRAI MIL-B-121, TYPE II, GRADE A TO MIL-B-131, CLASS 1, WITH TYVEK BACKING.

2. NOTE 9, II, PARA. (3); CHANGE SPEC. MIL-C-17106, TYPE 3 TO CC(428, TYPE 1.

R. F. ELLIS

APP. F-21



		613380-3	STRIP		STEEL	(SEE NOTES 1,2 & 3)	
		613380-2	STRIP		STEEL	(SEE NOTES 1,2 & 3)	
		613380-1	STRIP		STEEL	(SEE NOTES 1,2 & 3)	
NEXT ASSEMBLY	QTY REQD	PART NUMBER	DESCRIPTION	STOCK	MATERIAL	SPECIFICATION	DESIGN UTS PSI

LIST OF MATERIALS

MECHANICAL FINISH: SURFACE ROUGHNESS IN MICROINCHES

√ - THIS SYMBOL EMBRACING THE SURFACE ROUGHNESS (IN MICROINCHES) REPRESENTS THE MAXIMUM ACCEPTABLE ROUGHNESS, AND MAY BE PRODUCED BY ANY MECHANICAL PROCESS:
REF. SPEC. MIL-STD-10

DESIGNED FOR STEAM CATAPULTS

SUPERSEDES

DRAWN	J.V. MECCA	12 JAN 66
CHECKED	CICCARONE	13 JAN 66
MATERIAL		
ANALYZED		
SUPERVISOR		3/11/66
APPROVED		DATE
APPROVED		DATE

ENGINEERING DEPARTMENT (51)
NAVAL AIR ENGINEERING CENTER, PHILA., PA. 19112

TITLE
STRIP
COLD DRAWN
SEALING, LAUNCHING CYLINDER

CODE IDENT NO. 80020 | SIZE H | DRAWING NO. 613380

SCALE FULL | SHEET

I. REELING OF STRIP.

(1) STRIP IS TO BE REELED ON A 14 FOOT DIAMETER DRUM HAVING A C
12" I.D. AND APPROXIMATELY 15" O.D.

(2) CLEAN THE STRIP OF GRIT, OIL AND GRINDING LUBRICANT BEFORE WR
DRUM, USING METHOD C-1 OF MIL-P-116.

(3) APPLY PRESERVATIVE P-2, MIL-P-116, TO THE STRIP AS IT IS BEING W
THE DRUM.

(4) TIE THE FIRST COIL TOGETHER ADJACENT TO THE PIN WHICH SECURE
TO THE DRUM.

(5) WIND THE FULL LENGTH OF THE STRIP, APPLYING SUFFICIENT TENSION
FAIRLY TIGHT AND UNIFORM SPIRAL.

(6) AFTER THE STRIP IS WOUND ONTO THE DRUM, TIE ALL COILS TOGETHER
SPACED INTERVALS, WITH 4 STRANDS OF 3/32" DIAMETER 1x7 GALVANIZED SEIZING ST

(7) TO OBTAIN TIGHT WIRING, FORCE COILS TOGETHER WITH WOODEN WEDGE
ENING THE WIRES.

(8) TO PROTECT THE EDGES OF THE STRIP, PLACE GUARD CLIPS UNDER THE
AND ONE OUTSIDE OF THE SPIRAL, USING TWO TIES AT THE OUTER END OF THE STRIP

(9) AFTER THE STRIP HAS BEEN PROPERLY WIRED, REMOVE IT FROM THE REEL
OF A HOIST AND SHACKLE, THE PIN OF WHICH MUST HAVE A FIBRE SLEEVE TO PREVENT DAMAG

(10) LOWER THE STRIP CAREFULLY ON A WOODEN RAMP OR SKID WITH THE COIL
HORIZONTAL POSITION. PICK UP WITH 3 SLINGS, DO NOT USE HOOKS, AND TRANSFER TO THE PACKI

II. PACKING.

(1) COVER UP THE ENDS OF THE SEIZING WIRES WITH ADHESIVE TAPE.

(2) DOUGHNUT WRAP THE REELED STRIP WITH 3" WIDE GREASE-PROOF PAPER C
MIL-B-131, CLASS I, WITH TYVEK BACKING

(3) DOUGHNUT WRAP THE REELED STRIP WITH 4 INCH WIDE COTTON DUCK CC

(4) DOUGHNUT WRAP THE COTTON [illegible] WITH TWO (2) INCH WIDE TAPE CONF
ERAL SPECIFICATION PPP-T-60, CLASS 1, TYPE 3, [illegible] ALING ALL LAPS IN THE COTTON DUCK

(5) IN ORDER TO PROVIDE ADEQUATE PHYSICAL PROTECTION OF THE SEALING
THICK GALVANIZED STEEL CHANNEL SHALL BE PL[illegible] ED ON THE PERIPHERY OF THE COILED S
NELS (4 PIECES) SHALL BE 36 5/8" LONG, 2" WIDE AND 1" DEEP AND SHALL ENCLOSE THE
FERENCE OF THE COILED STRIP. THE CHANNELS SHALL BE SECURED BY USING THREE (3) S
(.070" x 5/8" WIDE) PER CHANNEL. A 1" x 2" x 6" PIECE OF WHITE PINE WOOD (FURRING STRIP)
EACH OF THESE THREE STRAPS ON THE I.D. OF THE COILED STRIP TO PROTECT THE STRIP
BY THE STRAPS.

[illegible] AT THREE PLACES EQUALLY SPACED AROUND [illegible] THE [illegible]
E END POINT RED.

(6) TO EACH STRIP SECURE A WATERPROOF ENVELOPE [illegible] HAVING [illegible]
T — BELOW). REEL PART NUMBER AND ITEM NUMBER AND ITEM THE REEL PART NUMBER AND ITEM
SHALL BE STENCILED ON OUTER END OF SHIPPING ROLL ONLY.

(7) STENCIL ON THE ENVELOPE THE FOLLOWING:

READ INSTRUCTIONS IN THIS ENVELOPE BEFORE UNREELING SEALING STRIP

III INSTRUCTIONS FOR HANDLING SEALING STRIPS

(1) FOR MOVING THE COIL, APPLY ROPE SLINGS AT SPOTS PAINTED RED. DO NOT USE
(2) PLACE COIL ON A FLAT SOFT SURFACE, NOT ON A CEMENT FLOOR.
(3) REMOVE THE COTTON DUCK CASTING AND PAPER WRAPPING.
(4) USE ALL POSSIBLE PRECAUTIONS TO PREVENT NICKING OF EDGES OR SURFACES
(5) REMOVING TIE TYING WIRES
(a) STAND INSIDE OF COIL WHEN CUTTING THE BINDING WIRES.
(b) TO PREVENT THE OUTER END OF THE STRIP FROM SPRINGING OFF, TIE ABOUT A
G CORD OR ROPE AROUND THE COIL ADJACENT TO THE FIRST WIRE TIE.
(c) REMOVE ALL OF THE TIE WIRES, EXCEPT THAT TYING THE FIRST INNER COIL TOG
UNTWISTING THE ENDS OF THE WIRES OR BY CUTTING THEM WITH DIAGONAL PLIERS. DO NOT USE A
[illegible] THE TEMPORARY ROPE TIE AT

APPENDIX G

MANUFACTURERS OF PROTECTIVE COATINGS CONTACTED

G-1 Aeromarine Technology, Inc.
Box 1396
Tustin, CA. 92680

G-2 Ameron, Corrosion Control Div.
201 N. Berry St.
Brea, Calif. 92621

G-3 Carboline Co.
328 Hanley Industrial Court
St. Louis, Mo. 63144

G-4 Devcon Corporation
Danvers, Mass. 01923

G-5 Devoe and Reynolds Co.
414 Wilson Ave.
Newark, N.J. 07105

G-6 Harco Corporation
4600 East 71st Street
Cleveland, Ohio 44125

G-7 Metco Inc.
1101 Prospect Ave.
Westbury, L.I., N.Y. 11590

G-8 Newage Industries Inc.
815-6 Greenwood Ave.
Jenkintown, Pa. 19046

G-9 Palmer Products Inc.
Worcester, Pa. 19490

G-10 Phila. Resin Corp.
P.O. Box 454
20 Commerce Drive
Montgomeryville, Pa. 18936

APPENDIX G (Cont'd)

MANUFACTURERS OF PROTECTIVE COATINGS CONTACTED

G-11 Quelcor Inc.
Paper Mill Road and Baltimore Pike — P.O. Box 33
Media, Pa. 19063

G-12 Spraylat Corporation
One Park Ave.
New York, N.Y. 10016

G-13 Thermo Cote Inc.
798 21st Ave.
Patterson, N.J. 07513

G-14 Tretolite Div.
Petrolite Corp.
369 Marshall Ave.
St. Louis, Mo. 63119

G-15 U.S. Polymeric
700 E. Dyer Rd.
Santa Ana, Calif. 92707

G-16 WD-40 Company
5390 Napa Street
San Diego, Calif. 92110

G-17 Wisconsin Protective Coating Corp.
Green Bay, Wisc. 54305

APPENDIX H

NEW CORROSION CONTROL TECHNIQUES AND DATA MILITARY AND COMMERCIAL

H-1 "Keeping Corrosion Under Control" Machine Design, Magazine (9-71)

H-2 "179 Years In Sea Water" Materials Protection and Performance, Publication, Vol. 1 (1-73) No. One

H-3 "Effect of Metallic Coatings and Zinc Rich Primers on Performance of Finishing Systems for Steel" Materials Protection and Performance, Publication, Vol. 11 (8-72) No. Eight

H-4 Marine Corrosion, Materials Protection and Performance, Vol. 12 (1-73) No. One

H-5 Corrosion Rates of Metals, Machine Design Magazine (11-73); Application Technique for Aluminum Coatings, Claremont Polychemical Corp.

FIGHTING THE COST CRUNCH

Keeping Corrosion Under Control

Almost every corrosion problem can be solved by a generous application of money. But in workaday industry, the trick is to meet service requirements with the most economical materials possible.

RONALD KHOL
Associate Editor

ANY CONSUMER seeing the salt-ravaged cars on Northern streets or the rusted air-conditioner housings on coastal cottages finds it hard to cheer industry's skill at combating corrosion. But precisely because of the corrosive blight so obvious in day-to-day living, industrial laboratories have been spurred to find better methods to stop the unholy alliance of oxygen and metal.

Corrosion, to be sure, is far from being under control. Especially for metals exposed to salt environments, protective measures are costly and not totally effective. Also, the dangerous and insidious form of deterioration called stress corrosion still plagues missiles, aircraft, nuclear reactors, and other high-strength structures. Yet the persistent and nagging forms of workaday corrosion that afflict common steels, aluminums, and other commercial metals are now being contained much more successfully than in the past.

Where Low-Cost Counts

Nobody in the fiercely competitive automotive and appliance industries throws money around needlessly, so some clues to the best measures for controlling corrosion under intensely cost-sensitive conditions can be found in approaches used in autos and appliances.

The salt air of coastal regions and the sulphur-dioxide laden air of industrial areas have always caused corrosion on automobiles. But what brought the problem to a head is the heavy use of salt on winter roads, particularly in the Great Lakes area.

Automobile designers apply a variety of coatings, each tailored to the severity of corrosion encountered at various locations on a car. Ordinary sheet steel not particularly prone to rust is simply treated with a zinc-iron phosphate conversion coating, and then sprayed or dipped with primer and finish coats of paint. Primary purpose of the phosphate pretreatment is to provide a surface that the paint can adhere to, and to prevent corrosion from spreading if it should find its way through an opening in the paint.

CORROSION CONTROL

Where slightly more protection is needed and where weld-through characteristics are not required, zinc-chromate primers are used. Zinc-rich paints are used where still greater protection is needed. The metallic zinc in these paints, if it constitutes at least about 85% of the pigment, sets up an electrolytic sacrificial action that protects the base steel by a mechanism similar to the one that protects galvanized or zinc-coated steel. Finally, galvanized steel is used where utmost protection is needed. Each step provides greater protection, but at progressively greater cost.

One company, Chrysler Corp., also uses sacrificial anodes, rather than a coating, to prolong the life of leaf springs. Thin strips of zinc, placed between the leaves, set up a sacrificial electrolytic action that retards corrosion.

Exhaust systems present a different challenge because of high heat and acids that form from combustion byproducts. Here, galvanized steel provides only about a 20% improvement in service life over bare steel, so aluminized steels are used. These steels more than double the average service life of bare steel. And to provide even greater protection on the "cold" side of the muffler, chromized steels are used.

One problem not completely resolved concerns the corrosion induced by stainless steel trim in adjacent steel sheet metal (which sacrifices to the more noble stainless). Backing the trim with nonconductive plastic fasteners or with a sacrificial layer of aluminum is a solution being tried to protect the adjacent body steel.

Plastics also are used on some cars as corrosion-fighting fender liners. But high cost and manufacturing problems keep most producers oriented toward steel in this application.

The most important emerging development, however, is the electrodeposition of paint, sometimes called paint plating. In this process, parts are submerged in a paint bath, and electric current is then applied to paint and workpiece so that paint solids are deposited or "plated" onto the part electrolytically.

The main advantage of this technique is the complete and thorough coverage it provides. As surfaces are covered, they become insulators and attract less paint, while areas with little or no coverage continue to attract the charged solids until they too are covered. The coverage—and resulting corrosion protection—are so good, in fact, that electrodeposition may place painted steel in many applications now dominated by galvanized steel.

Housewife's Corrosion Test

The most corrosion-prone home appliance is the automatic washer. "With the repeated exposure to water, humidity, and detergents, the washer makes a pretty good corrosion-test cabinet," says one engineer. The only thing missing is salt and outdoor exposure, but these ingredients show up in the environment of window air conditioners operating near the ocean. So in washers and air conditioners, appliance builders run most of the gamut of corrosive effects.

Much to their credit, appliance designers have pretty well come to grips with the problem. In fact, the major trouble identified by a corrosion expert at one company is far from earth-shaking. It is simple edge corrosion that creeps inward from the edges of trimmed sheet metal. It is undesirable only because it mars appearance.

The cause of edge corrosion is inability to get complete paint coverage on trimmed metal. One solution is to borrow a leaf from the automaker's book and use electrodeposition. Edge protection with this process is especially good because the current density — and thus paint deposition — are highest at edges.

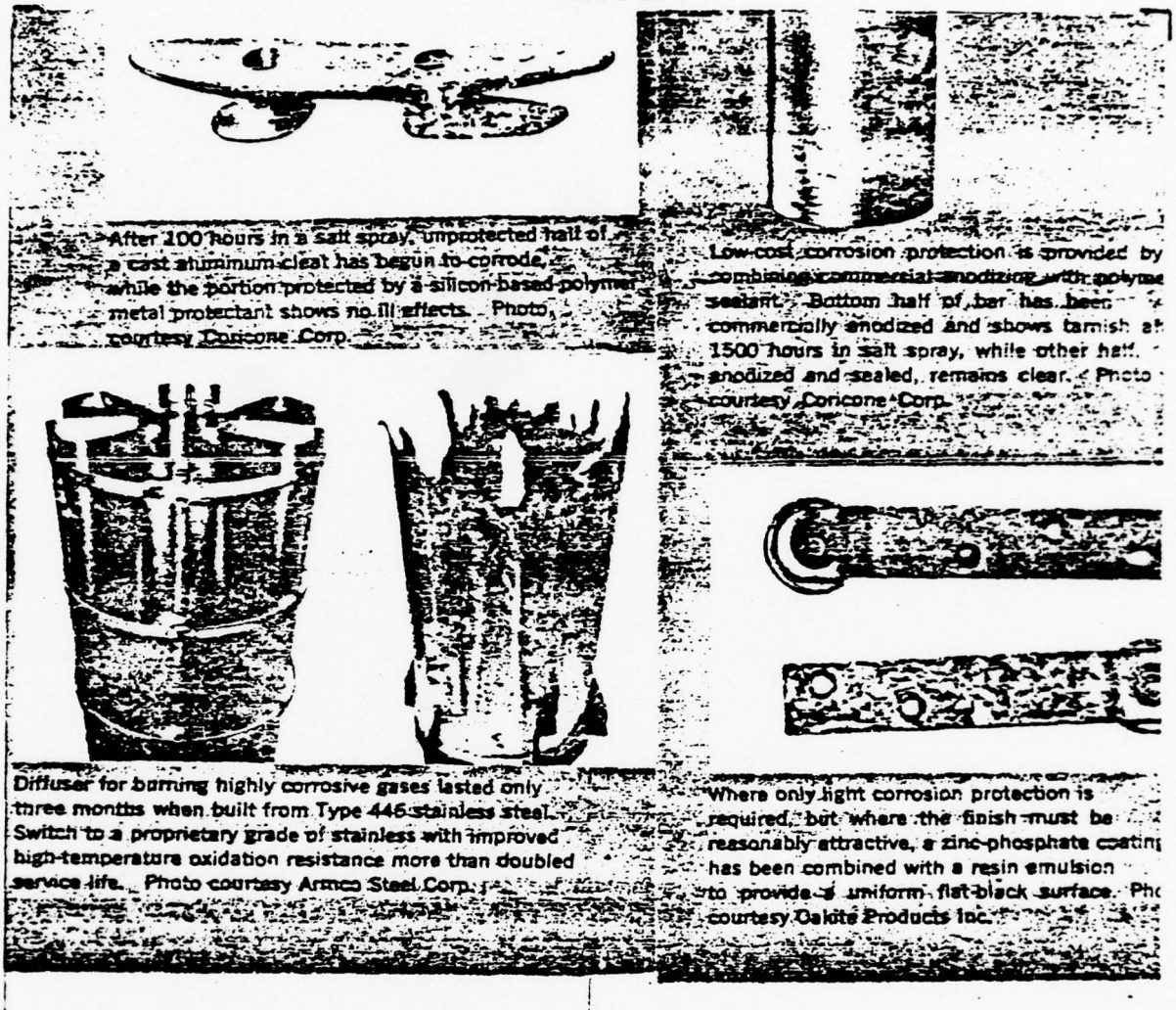
Another major problem recently solved by washing-machine producers concerns corrosion caused by water and detergents in zinc die-cast pump housings. Several companies overcame the problem by switching to injection-molded glass-filled plastic housings.

Some engineers expect an increase in the use of plastics to control corrosion in functional parts. However, they recommend caution in substituting plastics for metal since plastics have their own particular drawbacks.

So that air conditioners can hold up under the general effects of outdoor exposure, housings are usually made of galvanized steel. Electrodeposition of paint, however, is now opening the possibility of substituting ordinary painted steel for the more costly galvanized material.

The corrosive conditions for clothes dryers, refrigerators, and ranges are not as severe as those for washers and dishwashers, so manufacturers take advantage of this fact to save money on the finishing treatments. A dryer or a range, for example, might get an ordinary iron or zinc phosphate pretreatment, while the washer and dishwasher usually get a more costly microcrystalline zinc-calcium-phosphate treatment.

At least two major treatments are used for the inside tubs of dishwashers, which are subjected not only to strong detergents and hot water, but also to a high-temperature bake-off. Some manu-



After 100 hours in a salt spray, unprotected half of a cast aluminum cleat has begun to corrode, while the portion protected by a silicon-based polymer metal protectant shows no ill effects. Photo courtesy Coricone Corp.

Low-cost corrosion protection is provided by combining commercial anodizing with polyme sealant. Bottom half of bar has been commercially anodized and shows tarnish a 1500 hours in salt spray, while other half, anodized and sealed, remains clear. Photo courtesy Coricone Corp.

Diffuser for burning highly corrosive gases lasted only three months when built from Type 446 stainless steel. Switch to a proprietary grade of stainless with improved high-temperature oxidation resistance more than doubled service life. Photo courtesy Armco Steel Corp.

Where only light corrosion protection is required, but where the finish must be reasonably attractive, a zinc-phosphate coatin has been combined with a resin emulsion to provide a uniform flat-black surface. Pho courtesy Oakite Products Inc.

facturers feel that plastic-coated steel is satisfactory here, while others elect to use porcelain enameled steel.

Picking a Finish

The paints applied to appliances are also tailored to the end-use. Interior components not visible to the casual viewer simply receive a primer. An epoxy primer, for example, is commonly used. Some epoxies and urethanes, however, tend to yellow, so many companies do not specify them for finish coats or exterior surfaces where color retention is important. Thus acrylics, which are more expensive, often are used for the finish exterior coat.

Air conditioners are unique among home appliances in that they must withstand direct exposure to sunlight in addition to rain, snow, and occasional industrial or salt atmospheres. Manufacturers of air conditioners generally shy away from epoxies for parts exposed to sunlight because ultraviolet radiation causes chalking and a powdery look in epoxies. Although the chalking adheres tightly and actually provides superior corrosion resistance, homeowners don't care for the appearance. As a result, the acrylics and alkyds are normally used. Some designers, however, are thinking of switching to epoxies anyway—and then implementing an "educational campaign" to assure the buyer he is getting a good finish.

Many times, a minor amount of corrosion can be tolerated. In refrigerators, for example, most of the functional parts are hidden from view. Since the corrosive environment is not severe and the resulting oxidation is usually only superficial, the finishing specifications can be quite loose. In short, if the rust doesn't bother anyone, don't worry about it.

The same is true in automotive parts. Aluminum

CORROSION CONTROL

die castings used under the hood, for example, if left unprotected acquire rather unsightly—but functionally harmless—splotchy white corrosion products. If the part is high in the compartment where it is seen every time the hood is opened, it generally is finished with a conversion coating. If it sits low in the compartment and is not generally on view, it probably receives no surface treatment at all. The exceptions are zinc die castings, which usually are at least conversion-coated.

Stainless and Not So Stainless

When conversion coatings, paint, zinc coatings, or aluminum coatings don't fill the bill for protecting steel, the logical next step is to investigate stainless steels. There are more than 60 grades of stainless steel available in a wide range of prices. The expensive ones provide excellent corrosion resistance, while the lower-cost varieties aren't quite so "stainless."

The factor that indicates the corrosion resistance of a stainless steel essentially is its chromium content; the more chromium, the more corrosion resistance. The grades generally considered to have high corrosion resistance contain from about 11% to 30% chromium. Grades near the low end of this range cost the least and usually are chosen merely for their lustrous appearance. Grades near the high end provide maximum resistance to corrosion but are quite expensive.

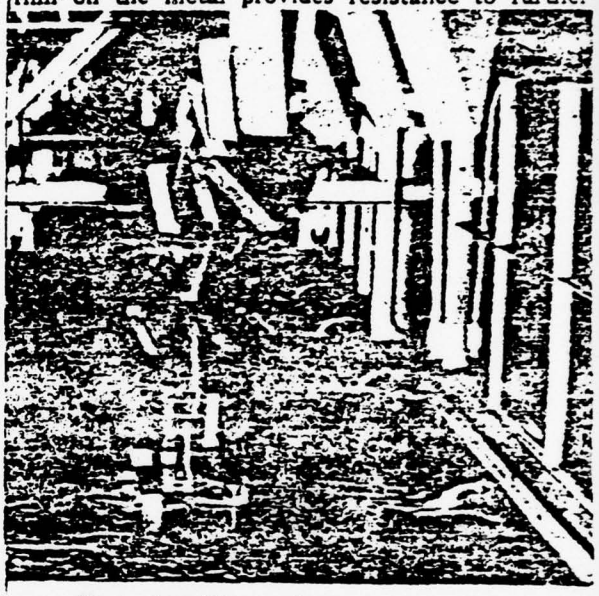
For years, the lowest standard grade was Type 410, with 12% chromium and which sells for about 53 cents per pound. This grade is widely used for machine parts, chute liners, fasteners, slides, and other such parts requiring a bit more corrosion resistance than ordinary steels.

Recently, "muffler" grades with 9% to 11% chromium have been introduced at prices of about 32 cents per pound. As the name implies, these lower grades are used chiefly for exhaust components on automobiles. They are not well suited to decorative uses because they tend to look streaky, especially if polished, and in salt air they take on a light rust.

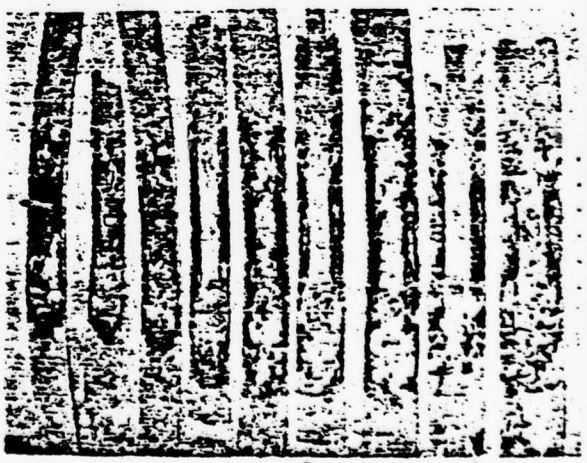
After Type 410, the next major jump in cost and performance is to the famous 18-8 series, including Types 302 and 304, with 18% chromium and 8% nickel. These provide significant corrosion resistance and are widely used in food and beverage-processing machinery, pharmaceutical processing equipment, medical equipment, some household appliances, and in architectural trim. But the cost, at about 60 cents per pound, is roughly twice that of the lowest grades.

Finally, Types 316 and 317 with 18% chromium and 12% nickel, are the costliest (at prices of around $1.00 to $1.50 per pound) and most corrosion resistant. These grades commonly are used in sea water and in certain acid environments.

Stainless steel generally has good corrosion resistance in oxidizing environments because an oxide film on the metal provides resistance to further



Electrodeposition produces a vast improvement in t corrosion resistance of painted surfaces. These enclosures for electronic controls are being painted by electrodeposition at the General Electric General Purpose Control Department.



Every other leaf in this disassembled automobile spring is a zinc-alloy interleave that inhibits corrosion in the steel main leaves. After 99,573 miles of testing by the Chrysler Corp., the corroded ends of the interleaves reveal sacrificial action.

deterioration. Stainless generally resists nitric acid, for example, but hydrochloric acids attack it, and chlorides pit it. It can withstand either extremely dilute or extremely concentrated sulphuric acid, but middle-range dilutions attack it.

Stainless steels with less than 16% chromium acquire some rust in sea water, but the initial staining doesn't progress much, and the metal maintains its corrosion resistance. However, marine organisms cannot be allowed to grow on the metal because they induce pits which break down the corrosion protection.

If stainless steel does not provide enough corrosion protection, the next choice is usually a high nickel or a cobalt-base alloy. This puts you in a cost range of about $2.00 per pound and up. Or perhaps titanium might be called for. Titanium, in fact, is one of the best of the common metals for resisting salt-water corrosion. Or maybe some other corrosion-resistant materials such as silicon-irons, graphite, and zirconium may be suitable.

Finally, at the top of the order—as far as resistance to acid corrosion is concerned—is tantalum, the workhorse of the chemical industry for coping with acid environments. Although practically a semiprecious metal, it is widely used and has a resistance to acid rivaling that of glass. In fact, the biggest competitors with tantalum in the chemical field are glass and two plastics, polyvinylchioride and Teflon. Tantalum, however, is not *universally* corrosion resistant because it is attacked by strong alkalies. But alkaline materials provide no particular problem in corrosion engineering because they can be handled quite well by common grades of steel.

The Cost Crunch in Action

Many—perhaps most—corrosion problems are combated simply by trying one material after another until the right combination of cost and corrosion resistance is found. Thus, some of the most difficult design jobs involve trying to provide the proper cost-effectiveness on the first go-around.

A case in point involves pollution-control work, and specifically the design of waste-heat boilers. The objective with these boilers is to burn garbage and dried sewage to produce steam which, in turn, would then be used to generate electric power.

"The corrosion problems involved in the operation of these boilers can be quite severe," according to a researcher at Battelle Columbus Laboratories, where studies are underway to find a solution. The waste materials to be burned contain many types of salts and chemicals, which are carried by the flue gas to the boiler tubes where they cause accelerated corrosion.

No firm solution is yet in sight, but two approaches are to find better materials or to regulate operating conditions so that they do not promote corrosion so readily.

The problem is further compounded by the fact that turning to stainless steel probably won't offer a solution because chlorides cause stress-corrosion cracking in these alloys. Even more expensive nickel alloys would probably do the trick, but then there is the question of whether the high cost could be justified.

Another avenue being investigated is the use of scrubbers to remove harmful agents after they leave the boiler. But the sulphur dioxide and chlorides in the gases make the water in the scrubbers very acidic. These acids attack virtually all commonly used metals. As a result, plastics are being investigated. They hold up fairly well so long as they do not overheat. And so it goes, each proposed solution bringing its own set of drawbacks and potential failings, until hopefully some ideal material or mix of materials will be found.

Other corrosion problems lurk undetected for years, only to surface later when remedies are difficult. Some of the earliest nuclear reactors, with 10 years or so service behind them, are beginning to age a bit. And some of the stainless steel piping in these reactors is developing stress-corrosion cracks—a long-term corrosion problem not foreseen when the reactors were built.

An Elusive Optimum

Even when virtually complete control of corrosion is possible, finding the most economical means of control often is difficult. If you want long-lasting bright trim on a product, should you use plated steel or stainless steel? If you want corrosion-resistance on some machine part, should you use electroless plating, or should you flame-spray it? The answer hinges not only on the performance and costs of each, but on whether the appropriate equipment is available.

Some manufacturers admit, for example, they would rather use galvanized steel rather than conventional conversion coatings and paint, but they are locked into a system by their investment in plant facilities. By the same token, some would prefer to use electrodeposition instead of more costly galvanized steel, but again are committed to a specific approach because they don't have the equipment required for a change.

Thus, the battle of the pocketbook goes even beyond mere engineering data and tabulations of finishing costs. Through it all, knowledgeable outsiders give industry high marks for its work against corrosion. A scientist at an independent research laboratory sums it up this way: "Engineers in industry try very hard to control corrosion. In fact, it's *surprising* how hard they try."

179 Years in Sea Water?

CARROL M. WAKEMAN,* JOHN W. STORER,** and ORVAL E. LIDDELL***

Conventional methods of in-place corrosion protection are both cumbersome and expensive, and many are not applicable to the protection of in-place piling. An investigation covering more than 25 years has shown that with a novel patented method of protecting steel piles in place, a minimum service life of at least 25 years with little or no maintenance can be expected.

IS THERE a maintenance procedure which will guarantee a life of 179 years for thin wall (0.048-inch) steel tubing in sea water? Perhaps not yet, but tests of steel pipes, protected by 30-mil wrappers of polyvinyl chloride, had a corrosion rate of 0.0002 inch/year (ipy). The success of field and laboratory tests provides a definite potential for the economic protection of steel piles against corrosion.

Wrapping Procedure

Briefly, the Pile-Gard† method is to encircle the piles with polyvinyl chloride (PVC) wrappers stiffened by rigid longitudinal pole pieces. The pole pieces are mated and rolled up by means of a ratchet wrench to provide a tight fitting, smooth, wrinkle free encasement that creates a hermetic seal around the pile. The wrappers are provided with watertight seals at the top and bottom of the module and further secured to the pile with metal bands. This is the same proven process that has been used commercially for the successful protection of wood piles against attack by marine borers since 1957. The method enables one or two men to attach a modular wrap, up to 16 ft long, either above or below water, in a matter of minutes (Figures 1 and 2).

Initial studies of wrapped wood piles showed that it was easy to create positive seals which would prevent either oxygen or water from reaching the substrate. This development led to the same wrapping procedure for the corrosion protection of steel members in an aqueous environment.

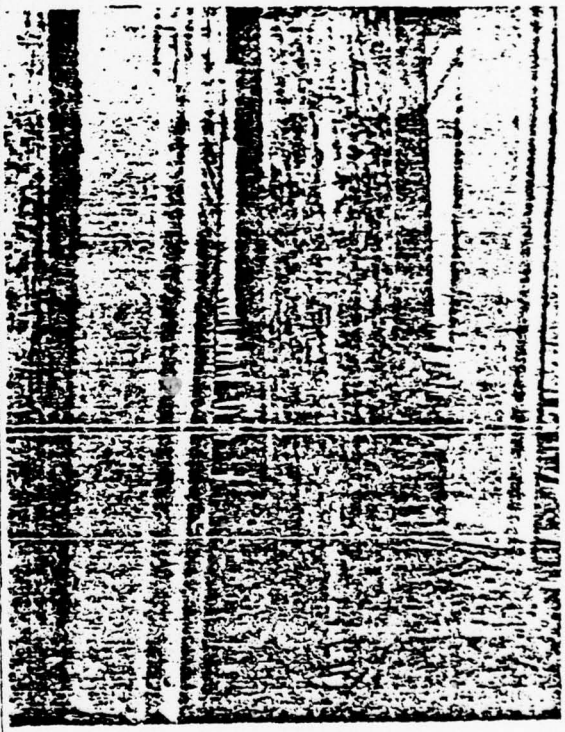


Figure 1 — PVC encapsulation protects wood piles from attack marine borers.

TABLE 1 — Results of Quantitative Corrosion Tests

Coupon Number	Original Size (cm)	Initial Weight (g)	Final Weight (g)	Weight Loss (g)
3	3.27 x 5.96	20.0769	19.9194	0.1575
4	3.58 x 4.58	16.0040	15.8995	0.1045
5	3.30 x 5.46	17.6336	17.5333	0.1003
6	3.13 x 4.95	15.0135	14.9564	0.0571

When the wraps were removed, the steel pipe underneath was silver bright with no visible signs of corrosion. Sanding marks were as evident as they were prior to the test. The coupons were remeasured and reweighed. Corrosion rates computed from the data shown in Table 1 were as follows: Coupon 3, 0.0001 ipy; Coupon 4, 0.0003 ipy; Coupon 5, 0.0003 ipy; and Coupon 6, 0.0002 ipy. Coupon 3 had been alone under the lower wrap which had trapped a smaller amount of water and less oxygen.

The smaller amount of corrosion indicated by these low rates was believed to be due to a very small leakage of water through the plastic wrinkles beneath the end seal bands, it being difficult to provide hermetic seals on 3-inch test pipe. It is very unlikely that wrinkles would develop on larger diameter piles. Uhlig[4] reports the corrosion rate of pickled steel in sea water at Cape May, N. J., to be 0.0038 ipy for continuously immersed steel.

When these test results are interpreted from a practical standpoint, it may be seen that the average life expectancy of a PVC protected pipe, of the thickness given in these tests, would be about 179 years—providing the PVC jacket would remain intact that long. From past experience, the anticipated service life of a PVC membrane should be well over 35 years. No tests to date have limited the life of PVC.

Controls

The ends of the test pipe were not wrapped. This was to compare the corrosion rate of bare steel with that protected by PVC in exactly the same environment.

The bare end of one of these pipes was cut in two after its 1-year exposure. The corrosion rate of the bare steel was 0.016 ipy, with a predicted life of 2.8 years. This compares with a rate 0.0002 ipy on steel protected with a PVC wrap-predicted life—179 years.

The very low corrosion rate of the unprotected steel was somewhat of a surprise as it turned out to be only about 1/3 of the rate reported by others for similar locations. Evidently, the marine fouling animals (prolific in the clear water off Catalina) had offered a measure of protection.

Based on the extremely successful results of long term service testing and detailed examination of commercial installations, the PVC wrapping of submerged metallic structures has proven to be completely feasible and economical. The most important applications would b encasement of steel piles under wharfs and offshore dr rigs, especially where conventional protective metho the intertidal and splash zones give uncertain results very high cost.

Conclusions

Steel piles will not corrode in a marine environm they are wrapped with PVC in the manner prescribed ir article; a minimum service life of at least 25 years c expected with little or no maintenance.

Wrapping in-place piles costs much less than ventional coatings because (1) materials and labor cos somewhat lower than with the usual coatings, (2) superficial cleaning of the piles to remove sharp projec is necessary, (3) a modular wrap can be applied to a 16 in-place pile (in the air or under water) in from 20 minutes, and (4) the surface of the piles do not have dry in order to apply the protective wrap.

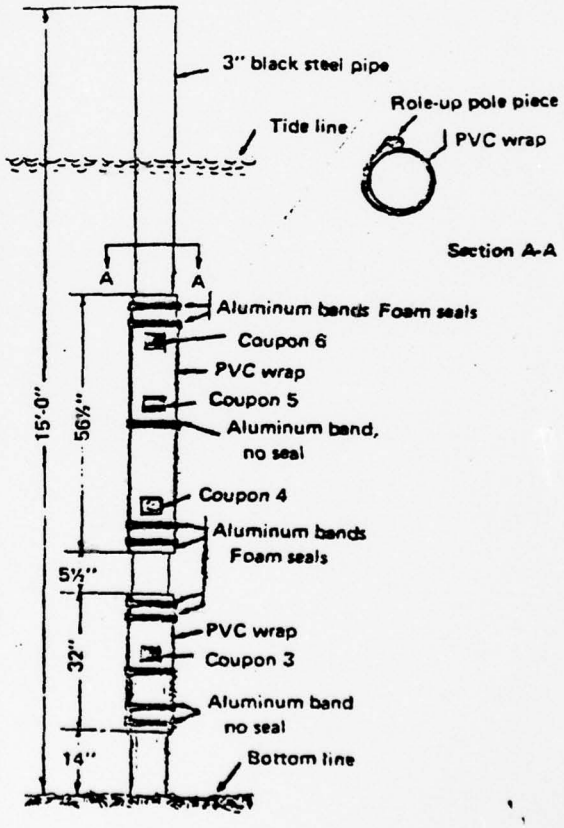


Figure 3 — Test assembly for quantitative measurement of corrosion loss under PVC wrap.

Effect of Metallic Coatings and Zinc Rich Primers on Performance of Finishing Systems for Steel

M. H. SANDLER, *U. S. Army Aberdeen Research and Development Center, Aberdeen Proving Ground, Md.*

MILITARY VEHICLES are exposed to a wide variety of corrosive climatic environments. Among the more severe exposures are salt atmospheres such as sea coast sites and humid tropical weather conditions. In November, 1965, the Coating and Chemical Laboratory was requested by the U. S. Army Tank-Automotive Command (TACOM) to conduct an exposure program to determine the effect of metallic coated steels and zinc rich primers on the corrosion behavior of finishing systems for automotive steels exposed to severe climatic conditions.

The tropical sites selected were a breakwater marine with very high atmospheric salt content, an open field, and a rain forest located at Fort Sherman, Panama Canal Zone. For temperate zone exposure, the test fence at Aberdeen Proving Ground, Md. was used. Panama is considered representative of most tropical environments, having consistently high but not extreme temperatures, high humidity, and abundant rainfall. The Fort Sherman area averages approximately 130 inches of rainfall a year with monthly means in the rainy season (May to December) from 12 to 22 inches and in the dry season (January to April) from 1.4 to 4 inches. The monthly mean temperatures range from 80 to 82 F with a daily range of 8 to 11 F. The monthly mean relative humidity ranges from 77 to 86%. Although the percentage of cloudiness is high, there are few days without some sunshine. Christobal, just across the bay from Fort Sherman, averages 6.3 hrs/day with monthly totals ranging from about 5 hrs/day in June, July, and November to about 8 hrs/day in March.

The breakwater site is situated at the junction of Limon Bay and the Caribbean Sea. The specimens at this site are exposed to constant spray of salt water with a salt fall for 1 year being calculated as 4514 lb/acre.[1] The open field site is approximately 1/2 mile inland from the breakwater and is subject primarily to rain and sun. The rain forest site is approximately 4 miles inland in a tropical evergreen forest composed basically of 3 tier tree growth ranging from 20 to 125 ft in height. Exposure here is primarily humidity and rain.

Note: This article is a revision of a paper of the same title presented at the 1971 NACE Western Region Conference. Copies of the original paper are available for $4.00 from *Materials Protection and Performance*, NACE, 2400 West Loop South, Houston, Texas 77027.

Test Specimens

All test specimens were 4 x 12 inch panels of the following metals:

1. Cold rolled steel, No. 20 gage (Federal Specification QQ-S-698).
2. Hot dip galvanized cold rolled steel, 20 gage, commercial quality, 1.25 oz/sq ft (0.5-1.0 mil zinc/side).
3. Electrolytic zinc coated cold rolled steel with 0.3 mil zinc plate/side. Minimum coating weight 0.10 oz/sq ft.
4. Aluminized steel, Type 1, 20 gage, hot dip coated on both sides with aluminum silicon alloy. Approximate coating weight per side 0.5 oz/sq ft (0.001 inch aluminum per side).

Surface Preparation and Painting

Surface preparation included solvent cleaning, wash primer (MIL-P-15328), and chromate conversion coating for the plated steels and zinc phosphate (TT-C-490, Type 1), wash primer, and sandblast for the cold rolled steel. Panels with each surface preparation were primed with specification alkyd-phenolic (MIL-P-8585), vinyl wash primer (MIL-P-15930), and epoxy (MIL-P-52192, MIL-P-23377) primers and topcoated with specification semi-gloss olive drab alkyd enamel (TT-E-529) and vinyl lacquer (MIL-L-1...) resulting in a total of 8 primer-topcoat systems for each surface preparation. In addition, a group of sandblasted steel panels were primed with a specification organic zinc rich primer (MIL-P-46105) and a proprietary inorganic zinc rich primer for comparison to the plated steels. The zinc primed panels were coated with the two previously mentioned topcoats and vinyl-alkyd enamel (MIL-E-1...

TABLE 1 – Surface Preparation and Finishes

Surface Preparation	
Solvent clean	1:1 by volume aliphatic naphtha (TT-N-95) – ethylene glycol monoethyl ether (TT-E-781).
Sand blast	SSPC-SPS-52T, blast cleaning to white metal.
MIL-P-15328	Primer (wash) pretreatment (Formula 117 for metals).
MIL-C-5541	Chemical films and chemical film materials for aluminum and aluminum alloys, Type II, Grade C, Class 2.
Chromate conversion	Proprietary for galvanizing.
TT-C-490 (Type I)	Cleaning methods and pretreatment of ferrous surfaces for organic coatings.
Primers	
MIL-P-8585	Primer coating, low moisture sensitivity.
MIL-P-15930	Primer, vinyl zinc chromate type.
MIL-P-52192	Primer coating, epoxy.
MIL-P-23377	Primer coating, epoxy polyamide, chemical and solvent resistant.
MIL-P-46105	Primer coating, weld-through, zinc rich.
Inorganic zinc rich	Proprietary.
Finish Coats	
TT-E-529	Enamel, alkyd, semi-gloss.
MIL-L-14486	Lacquer, vinyl resin, semi-gloss.
MIL-E-13515	Enamel, vinyl alkyd, semi-gloss.

The alkyd and vinyl-alkyd coated panels were prepared with and without a tie coat of wash primer. Surface preparation and finishing systems used are listed in Table 1.

The test panels were given the applicable pretreatments, and the coatings were spray applied using an automatic spray apparatus to assure film uniformity. Wash primer, MIL-C-15328, was applied to a dry film thickness between 0.3 and 0.5 mil; zinc rich primers between 2.0 and 2.5 mils; and all topcoats 0.9 to 1.1 mil except when applied over the proprietary zinc rich primer which required two coats or a thickness of 2.0 mils to obtain a uniform appearance.

Exposure

In July, 1966, the specimens were placed on exterior exposure at the four test sites. The racks at the breakwater face north in the direction of the prevailing trade winds; those in the open field and rain forest face south. All were mounted at an angle of 30 degrees. The racks at Aberdeen Proving Ground face south at an angle of 45 degrees.

Evaluation

At approximately 6 month intervals for up to 40 months and yearly thereafter, the panels were examined for corrosion and/or blistering at the score and for general surface condition and were given a rating from 0 to 5 with 0 being the worst rating. Score ratings were based on none to 1/4 inch corrosion and/or blistering from the score. Surface condition ratings were based on ASTM D 610 for corrosion alone and for corrosion accompanied blistering and on ASTM Method D 714-56 for blister alone.

In general, ratings of 5 and 4 are considered to pro satisfactory protection. Panel evaluation cannot alway clearly defined by numerical rating, especially when condition of the specimen falls at the border of possible ratings; thus, the number assigned is left to judgement of the evaluator. For this reason, the rating specimen was not considered complete until it received same numerical rating for 2 consecutive rating periods. is of particular concern in ratings of 4 and 3 since former is considered satisfactory and the latter un factory. Therefore, until two consecutive ratings were same or lower, the specimen was considered to have higher rating.

Reproducibility among replicate specimens was e lent in most cases. Although there are occasional excep to be found in the data, the scope of the program considered sufficiently broad to show general trends a provide a meaningful guide for the selection of sui finishing systems. As expected from previous exp studies,[2,3] the breakwater is by far the severest site the major cause of failure being corrosion and/or blist at the score. This is shown in Table 2 which list percent of systems with ratings less than 4 for each c rating elements.

Test results indicate that hot dip galvanized properly finished will offer the most effective corr resistant system for severe environments such as atmosphere and sea coast site. This is followed in des ing order by aluminized steel, zinc rich primer on rolled steel, electrolytic zinc, and cold rolled steel differences between the metallic coated steels are muc pronounced under less severe exposure with the galva steel, aluminized steel, and zinc rich primed cold steel being generally comparable followed by the el lytic zinc and cold rolled steel.

With regard to metal pretreatment prior to pai wash primer was more effective with the hot dip galva steel than the chromate conversion coating under exposure of the sea coast, whereas comparable perfor was noted at the other sites. The reverse of this was tr the aluminum coated steel, i.e., MIL-C-5541 chroma was more effective than wash primer at the sea coas

TABLE 2 – Failure Mode After 40 Months' Expos (Percent of 106 Systems Rated)

	Breakwater	Rain Forest	Open Field	Aberdeen Grou
Score only	58	20	32	38
Score and surface	27	1	2	4
Surface only	8	9	7	4
Total all conditions	93	30	41	44

However, as indicated earlier, the hot dip galvanized substrate provided the most effective performance with 5 systems still rated 4 or better at all sites after 40 months exposure vs 2 systems utilizing aluminized steel (Table 3).

Truck Body Experiment

On the basis of the data obtained after 13 months' exposure, TACOM contracted for the experimental fabrication of three truck bodies (cab and bed) with conventional cold rolled, aluminized, and hot dip galvanized steels. They were finished with a primer topcoat system consisting of MIL-P-8585 zinc chromate primer and TT-E-529 semi-gloss enamel. Metal pretreatment included zinc phosphate TT-C-490 for the cold rolled steel, chemical conversion coating MIL-C-5541 for aluminized steel, and wash primer MIL-P-15328 for the hot dip galvanized.

The vehicles were sent to the Canal Zone and placed in operation in January, 1967. They were used daily in every day transportation of men and materials and were rotated monthly between users. In this manner, the vehicle was used for 1 month on the Atlantic coast of the isthmus where rainfall averages 130 inches/year and the atmosphere is salt laden; for another month on the Pacific side where annual rainfall averages 70 inches; the third month the vehicle was used by a crew of a special project with the vehicle being driven on both sides of the isthmus. The vehicles were used on both improved and unimproved roads and exposed to jungle conditions as well as those of a moderately industrialized, urban area. They were washed weekly with cold water only.

After completion of one year of service, the vehicles were inspected, and the following observations made:

1. The galvanized steel showed some rusting at welded areas where the galvanize had been burned away during welding. The truck bed was in excellent condition with no signs of rust even when the paint film had been damaged.

2. The aluminized steel also showed some rusting at the welded areas. The truck bed was beginning to show some signs of rust where the paint film had been damaged.

3. On the cold rolled steel, the welded areas were rusting the same as the other two vehicles. However, where paint was damaged on the truck bed and other areas, rusting was quite evident. The sill of the driver's door, where the paint had been worn away, also showed noticeable rusting. This was not the case with the other bodies.

The same trends were also noted at the 2-year inspection period.

TABLE 3 – Systems Rated 4 or Better at all Sites, 40 Months' Exposure

Pretreatment	Primer	Topcoat
Hot Dip Galvanized Steel		
MIL-P-15328	MIL-P-8585	TT-E-529
MIL-P-15328	MIL-P-8585	MIL-L-14486
MIL-P-15328	MIL-P-52192	TT-E-529
MIL-P-15328	MIL-P-52192	MIL-L-14486
Chromate conversion	MIL-P-52192	TT-E-529
Aluminized Steel		
MIL-C-5541	MIL-P-8585	MIL-L-14486
MIL-P-15328	MIL-P-15930	MIL-L-14486

Lennox on Marine Corrosion

The following is an exclusive MP&P interview* with T. J. Lennox, Jr., a research chemist in the Marine Corrosion Section, Physical Metallurgy Branch, U. S. Naval Research Laboratory, Washington, D. C. Lennox holds a BS from Wagner College, Staten Island, N. Y., and is accredited as an NACE Corrosion Specialist.

Q. *What are the primary corrosion mechanisms which occur in the marine environment?*

A. The marine environment shows no limitations on the types of corrosion that may be encountered. Depending on the metal or alloy being used, the design of the structure, and the specific local conditions, one may encounter the following types of corrosion: crevice corrosion, exfoliation, dealloying, pitting, galvanic corrosion, erosion-corrosion, stress corrosion cracking, corrosion fatigue, stray current corrosion, and anaerobic bacterial corrosion. Generally speaking, the most serious corrosion in the marine environment is of a localized nature.

Q. *What alloys are commonly used offshore? What are their specific limitations?*

A. When one considers auxiliary equipment in addition to the offshore structure, many metal alloys are used. Of course, the primary metal is structural steel. Auxiliary equipment may be constructed from aluminum alloys, stainless steels, galvanized steel, aluminized steel, copper alloys, and in some instances where high performance in the unprotected condition is required, upgraded stainless steels, specific copper-nickel alloys, or super alloys may be used.

These materials other than perhaps some of the super alloys may corrode in several different ways. Galvanic corrosion can occur between many of the alloys. Pitting and crevice corrosion will occur on many of the aluminum alloys. Some of the higher strength aluminum alloys may exfoliate in the marine environment. Being amphoteric, aluminum alloys may also cathodically corrode from an excessive amount of cathodic protection or stray current. The common grades of stainless steel are very susceptible to crevice corrosion and pitting under relatively quiescent conditions in sea water. Some of the precipitation hardening stainless steels may also be susceptible to hydrogen cracking. The life of galvanized steel and aluminized steel is limited by the zinc or aluminum coating thickness. Many of the copper alloys will dealloy in the marine environment. High strength steels, aluminum, and titanium alloys may also be susceptible to stress corrosion cracking.

Q. *What new materials and/or design concepts are being used in the construction of offshore platforms?*

A. There are many instances, especially on auxiliary equipment, where the material selected may not be a new material, as such, but it may be new

*The views expressed in this interview are not to be construed as being the official opinion of the Naval Research Laboratory or the Department of the Navy.

for the application. Unfortunately, there are very few metals or alloys which are corrosion resistant under all conditions in the marine environment without some type of protection. Materials that are resistant generally have drawbacks such as high initial cost and difficulty in fabrication.

The availability of sound methods of applying cathodic protection from galvanic anodes of magnesium, zinc, and aluminum or impressed current systems in conjunction with protective coatings has been and will continue to be the basis for providing corrosion control to most offshore structures that require a long life span. The design concept of installing a galvanic anode cathodic protection system using massive size anodes for long life certainly appears to be a well thought out and useful procedure.

Q. *What are the most important factors to consider in materials selection for offshore structures?*

- Life desired.
- Strength requirements.
- Fatigue and stress corrosion characteristics.
- Inherent corrosion resistance to the many types of corrosion possible.
- Protective coating requirements.
- Cathodic protection requirements.
- Velocity conditions.
- Erosion-corrosion effects.
- Possible ice damage to protective coatings and cathodic protection system.
- Storm damage.
- Initial cost.
- Maintenance costs.

One of the major problem areas in the marine environment involves the unwise choice of materials for many applications. Under relatively quiescent sea water conditions, the common grades of stainless steel will severely crevice corrode or pit. The old concept of avoiding crevices as a remedy to this problem is without merit. Generally it is not practical to design a crevice free structure. Even if one attempts to eliminate crevices in a structure, new crevices may be formed by the sealant or shield material. In addition, crevices can be formed by the casual attachment of a material with a shielding capability such as marine fouling.

Corrosion Test Results After 12-Year Exposure

New data are in on continuing ferrous-metal corrosion tests conducted by American Society for Testing Materials.

In 1958, specimens (324) were set out at five different test sites, which included rural, industrial, and marine atmospheres. Exposure reports were made after 1, 3, and 7 years. For the 12-year report, sets of triplicate samples were removed from the test sites for evaluation.

Caution is expressed by ASTM concerning the application of any atmospheric corrosion test results. Nevertheless, the following general conclusions were drawn:

- Corrosion rates diminish the longer a metal is exposed to the atmosphere. For iron castings, the 12th-year rate is only about ¼ that of the first year.
- Ductile irons appear to exhibit insignificantly lower corrosion rates than either ferritic or pearlitic malleable iron.
- Pearlitic matrices tend to have some 60 to 75% of the corrosion rates of comparable ferritic materials.
- Surface appearance is not a sound basis for evaluating the extent of corrosive attack.
- Machined ferritic and pearlitic malleable irons suffer 12 to 25% higher corrosion rate than the corresponding unmachined irons.
- An addition of 0.5% copper to malleable iron improves its corrosion resistance by about 20%. The benefits of alloying appear to increase with time.
- One-year exposures are not sufficient to predict trends, because the rates of corrosion change over long time exposures for various metals.
- Higher alloy additions, as in the Cu-Cr-Ni (Corten) mild steels, reduce the rates of attack suffered by conventional unalloyed mild steel to below the levels of a malleable iron alloyed with 0.5% copper.
- All materials are attacked most severely at the ocean site.

Twelve of the 15 ferrous alloys tested were cast as ½-in.-thick plates. Two of the alloys were ductile iron, 5 were ferritic and 5 were pearlitic malleable iron.

APPENDIX J

CORROSION CONTROL RESEARCH DATA SOURCES

COMMERCIAL AND MILITARY

J-1 National Society Corrosion Engineers
2400 West Loop South
Houston, Texas 77027

J-2 Corrosion Science
Pergamm Press
Maxwell House, Fairview Park
Elmsford, N.Y. 10523

J-3 Materials Protection and Performance
2400 W. Loop South
Houston, Texas 77027

J-4 U.S. Naval Research Laboratory
Marine Corrosion Section
Washington, D.C.

J-5 U.S. Army Aberdeen Research
and Development Center
Aberdeen Proving Ground, Md.

J-6 Department of the Army
Army Materials and Mechanics Research Center
Watertown, Mass. 02172

J-7 Defense Supply Agency
Defense Documentation Center
Cameron Station Alexandria, Va. 22314

J-8 The Engineering Index Annual
Engineering Societies Library
345 E. 47th St. N.Y., N.Y. 10017

APPENDIX J-1A

NATIONAL ASSOCIATION OF CORROSION ENGINEERS

TYPICAL REPORTS OR PERIODICALS LISTED

1. Corrosion Course Reports

   Principles of Corrosion
   Industrial Methods of Combating Corrosion
   Coating Specification, Application

2. Basic and Applied Corrosion Research Office of Naval Research

3. Problem Solving with Plastics. Twenty-one papers cover the use of plastics in process industries. Included are descriptions of major corrosion problems and discussions of how plastics can be used to solve them.

4. Coatings and Linings for Immersion Service. Prepared by NAEC Unit Committee T-6A on Coatings and Lining Materials for Immersion Service, the book gives comprehensive information on topics such as safety, surface preparation, inspection, curing, and others.

5. Corrosion Abstracts Covering World Wide Corrosion Control Literature

APPENDIX J-7A

DEFENSE DOUMENTATION CENTER

ANNUAL ABSTRACTS INDEX

TYPICAL REPORTS LISTED

1. Problems with Anti-Corrosive Paints and Coating Systems AD877189
2. Corrosion Studies of Rust-Inhibited Hydraulic Fluid AD863478
3. Recent Development, Corrosion and Compatibility-Coatings AD869538
4. Sea Water Corrosion Protection of Metals AD877290
5. PRESERVATION-Investigation of Corrosion Prevention Behavior of Preservatives AD871681
6. Corrosion Bibliographies-List of Publications AD863915
7. Reports and Documents Relating to Corrosion AD872779

APPENDIX J-8A

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TYPICAL REPORTS LISTED

CORROSION CONTROL

1. Metals to Resist Corrosion
   B. J. Sunter, Australia 09439

2. Evaluation of Coatings
   W. A. Hutchinson 19572

3. Reaction between SO_2 and Wet Metal Surfaces
   N. G. Vannerberg Sweden 27853

4. Symposium on Basic and Applied Corrosion Research
   38380

5. Rust preventives. Selection and use; G. G. Levy; ASTME Eng Conference-Eng Matls Finishing & Coating-Collected Papers v 69 Book 8 May 5-9 1969 paper FG69-113, 14 p; It is very important that parts be clean and dry prior to being coated with rust preventive compounds. Should residues of chlorinated or sulfur containing cutting oils or metallic chips be left on the parts prior to rustproofing, the results can be disastrous, in that the rustproofing material will not stick, or corrosion can occur under the film of rust preventive.
   20906

APPENDIX K

NEW PROTECTIVE COATING DATA SPECIFICATION SHEETS

	MATERIAL NO.	MANUFACTURER*
K-1	No. 81 & No. 82	Amercn Co.
K-2	Prob	Carboline Co.
K-3	Carbo Zinc II	Carboline Co.
K-4	190HB	Carboline Co.
K-5	201 Devran	Devoe and Raynolds Co.
K-6	Catha-Coat 302	Devoe and Raynolds Co.
K-7	105SF	Metco Co.
K-8	Quelaqua	Quelcor Inc.
K-9	1075	Quelcor Inc.
K-10	SC-1074B-1	Spraylat Corp.
K-11	SC-1090	Spraylat Corp.
K-12	SC-270	Spraylat Corp.
K-13	N-4 (55)	Thermo Cote Inc.
K-14	Thermo-Cote I Thermo-Cote 149 Thermo-Cote 149A-11	Thermo Cote Inc.
K-15	Protexo-Cote V-12	Thermo Cote Inc.
K-16	Protexo-Cote BL	Thermo Cote Inc.
K-17	PC-8151; PC-8152	U.S. Polymeric

NEW PROTECTIVE COATING DATA SPECIFICATION SHEETS (Cont'd)

	MATERIAL NO.	MANUFACTURER*
K-18	PC-8220	U.S. Polymeric
K-19	PC-8230	U.S. Polymeric
K-20	WD-40	WD-40 Co.

* Addresses Listed in Appendix G.

SUBMARINES

AMERON
Corrosion Control Division
Brea, California 92621

RECOM-MENDATION*	NUMBER OF COATS	AMERCOAT PRODUCT	TYPE	TOTAL DRY FILM THICK-NESS (MILS)	APPLICATION METHOD
EXTERIOR					
KEEL TO WATERLINE					
I	1	No. 83 Primer[5]	Polyamide-Cured Epoxy	2	Airless or Conventional Spray; Br
	1	No. 84[5]	Polyamide-Cured Epoxy	6	Airless or Conventional Spray; Br
	1-2	Navy-approved antifouling	—	—	—
TOPSIDES					
I	1	No. 83 Primer[5]	Polyamide-Cured Epoxy	2	Airless or Conventional Spray; Br
	1	No. 84[5]	Polyamide-Cured Epoxy	6	Airless or Conventional Spray; Br
INTERIOR					
TANKS, BALLAST					
I	1	No. 81 Primer[6]	Polyamide-Cured Epoxy	2	Airless or Conventional Spray; Br
	1	No. 82[6]	Polyamide-Cured Epoxy	6	Airless or Conventional Spray; Br
II	1	No. 78[1]	Coal Tar Epoxy	8	Airless or Conventional Spray; Br
	1 or	No. 79[1]	Coal Tar Epoxy	8	Airless or Conventional Spray; Br
VINYL FOAM OR ASBESTOS INSULATION					
I	2	No. 1768[7]	Water-Based Flexible Vinyl	6	Conventional Spray; Brush; Roller

*Abrasive-blasting of steel surfaces is advised as proper surface preparation for all Amercoat Marine Coating recommendations.

1 Conforms to U.S. Navy Specification MIL-P-23236 (Ships), Type I, Class 2 — Coal Tar Epoxy. Also acceptable for use on U.S. Coast Guard vessels.

3 Conforms to U.S. Navy Chapter 9190 as a self-curing inorganic zinc silicate coating approved for application to hulls above waterline, decks and superstructures of U.S. Navy vessels.

over post-cured inorganic zinc app
MIL-P-23236.

6 Conforms to U.S. Navy Specific
23236 (Ships), Type I, Class 1—
ing Systems, Steel Ship Tank

Specialty Products
DIVISION

PROB

SELECTION DATA

ENERIC TYPE: Corrosion resistant complex of rust inhibitors.

ENERAL PURPOSE: Protect sharp edges of bolt and nut threads where rusti will prevent disassembly. A brush coat of PROB forms a corrosion resis barrier composed of a unique rust inhibiting binder and thousands of over-lapping aluminum platelets. PROB prevents seizure and corrosion caused high humidity and mild chemical fumes. PROB is a permanently soft film which can easily be removed with solvents when desired.

ECOMMENDED USES: Protection of pipe threads, bolt and nut threads. Em gency repair of damaged protective coating films. As a sealant in crevic to prevent rust streaking. Protect pump frames, bases; all types of bolte down equipment bases.

NOT RECOMMENDED FOR: Exposure to solvents, immersion applications.

CHEMICAL RESISTANCE:

Exposure	Fumes
Acids	Good
Alkalies	Good
Solvents	Fair
Salts	Excellent
Water	Excellent

TEMPERATURE RESISTANC

Continuous	200°F
Non-continuous	250°F

FLEXIBILITY:	WEATHERING:	ABRASION RESISTANC
Excellent	Good	Poor

SURFACES: Clean or previously rusted metal surfaces.

SURFACE PREPARATION: For optimum performance, wipe with rag to rem loose dirt from surface.

PRIMER REQUIRED:	TOPCOAT REQUIRED:
None	None

COMPATIBILITY WITH OTHER COATINGS: Will adhere to epoxy esters, al vinyls, acrylics, catalyzed epoxies, phenolics, oil based and oleoresinou coatings.

PROB

SPECIFICATION DATA

SOLIDS CONTENT:
By Wt. 82% ± 2%
By Vol. 77% ± 1%

FILM THICKNESS PER COAT:
9 mils (wet)
7 mils (dry)

COLORS: Aluminum only.

*THEORETICAL YIELD:
1232 mil ft./gal.

*THEORETICAL COVERAGE PEF
GALLON: 176 sq. ft. /@ 7 mils d

NOTE: *Material losses during appli cation will vary and must be taken in consideration when estimating job re quirements.

APPLICATION DATA

METHOD OF APPLICATION: Brush (In pint units a brush is supplied in the tc of the can).

MIXING RATIO: 1 package system.

FINAL DRYING TIME: Coating remains permanently soft -- may be easily removed at any time with Carboline Cleaner #2 or xylol.

THINNER USED: None required.

DRYING TIME BETWEEN COA
Normally only 1 coat required, desirable may be topcoated imm diately or any time thereafter.

SHELF LIFE: 1 year minimum.

ORDERING INFORMATION

COST:

	1's	Pints
PROB	$38.00/Case of 4	$39.00/Case of

SHIPPING WEIGHT:

4 gallon Unit	38 lbs.
Case of 12 Pints	14 lbs.

FLASH POINT: (Cleveland Open

PROB	102°F

END-NAEC-2455(REV. 2-68)
PLATE NO. 11962

APP. K-3

Carboline

PRODUCT DATA SHEET

CARBO ZINC 11

U.S. Patent 3,056,684

SELECTION DATA

GENERIC TYPE: Self curing, zinc-filled inorganic coating. The coating consists of a basic zinc silicate complex. (Furnished in two parts, Base and Zinc Filler, which are mixed just before use.)

GENERAL PURPOSE: A virtually permanent patented inorganic zinc base coat that protects steel galvanically, eliminating sub-film corrosion. Has outstanding application properties.

RECOMMENDED USES: Carbo Zinc 11 is used as a single coat protection of steel structures in weathering and marine exposures and as a base coat for organic and inorganic topcoats in more severe services. Excellent for the interiors and exteriors of storage tanks containing fuels and organic solvents. Has many uses as a maintenance primer, with or without topcoats, depending on exposure. Used widely in chemical plants, paper mills, refineries and coastal or salt atmospheres including offshore structures. Carbo Zinc 11 conforms to Los Angeles Rule 66 and Bay Area Regulation 3.

NOT RECOMMENDED FOR: Immersion or in direct exposure to acids or alkalies.

TEMPERATURE RESISTANCE:

Maximum — Continuous 750° F
Maximum — Non-continuous 800° F
Minimum — Below minus 60° F

IMPACT RESISTANCE: Very Good

FLEXIBILITY:	WEATHERING:
Fair	Excellent

ABRASION RESISTANCE: Excellent. The abrasion resistance of Carbo Zinc 11 increases as the coating ages.

SURFACES: Steel, cast iron, galvanized steel, stainless steel, aluminum.

COMPATIBILITY WITH OTHER COATINGS: Use over uncoated surfaces, Carbo Zinc 11, Carbo Weld 11 and other zinc coatings as recommended.

SPECIFICATION DATA

SOLIDS CONTENT: By wt. 80% ± 2%

VOLUME OF DRY FILM — THEORETICAL: 1000 mil ft. per gal. kit.

FILM THICKNESS PER COAT: 3 mils

COVERAGE * PER GAL. KIT — VOLUME OF DRY FILM (THEORETICAL): 333 sq. ft. @ 3 mils. As measured by standardized Mikrotest or Elcometer.

SURFACE PREPARATION: Remove oil and grease deposits. Commercial blasting is satisfactory for non-immersion service. White blasted steel is required for immersion service other than solvents. Pickled steel may be used. Since pickling processes vary obtain specific Carboline recommendation.

TOPCOAT: (Optional) — Can be topcoated with epoxy, epoxy-coal tar, vinyl, acrylic, silicone, modified phenolic and chlorinated rubber types. Consult with Carboline for specific recommendations.

APPLICATION DATA

TEMPERATURE AND HUMIDITY: (During application and drying.) Temperature 0° F to 200° F. Rel. humidity as high as 95%. Can be applied over slightly damp surface.

SUGGESTED CURING TIME: At 50% relative humidity (Prior to placing in immersion service or before applying topcoats).

85° F or higher	6 — 8 hours
60° F to 85° F	8 — 12 hours
40° F to 60° F	12 — 16 hours
0° F to 40° F	16 — 24 hours

For solvent immersion service allow 48 hours at 75° higher.

NUMBER OF COATS: Normally one.

METHOD OF APPLICATION: Spray. May be brushed for touchup.

SHELF LIFE: 9 months minimum.

COLORS:	POT LIFE:
Gray and Green	8 hours @ 75° F

THINNER USED: Carboline Thinner #33 (up to 1 qt. per gallon.)

ORDERING INFORMATION

COST PER GALLON: FOB Xenia, Ohio — Net 30

	5's	1's
Carbo Zinc 11 Gray or Green (Kit)	$12.80 Net	$14.20 Net
Carboline Thinner #33	2.65 Net	3.20 Net

THEORETICAL COST PER SQUARE FOOT — BASED ON VOLUME OF DRY FILM: 3.84¢ (3 mils)

THEORETICAL COST PER MIL FOOT: 1.28¢

FLASH POINT: (Cleveland Open Cup)

Carbo Zinc 11 Base Gray or Green	7
Carboline Thinner #33	14
Carbo Zinc 11, mixed and thinned, ready to spray	8

SHIPPING WEIGHT:

CARBO ZINC 11 RESISTANCE TABLE

EXPOSURE		CLASS A CONTINUOUS IMMERSION	CLASS B HEAVY FUMES LITTLE, OR NO SPLASH, OR SPILLAGE	CLASS C OUTSIDE WEATHERING AND MILD FUMES
ALTS	Without Topcoat	Fair	Excellent	Excellent
	With Recommended Topcoat	Excellent	Excellent	Excellent
OLVENTS	Without Topcoat	Excellent	Excellent	Excellent
	With Recommended Topcoat	Excellent	Excellent	Excellent
RESH AND ALT /ATER	Without Topcoat	Good	Excellent	Excellent
	With Recommended Topcoat	Excellent	Excellent	Excellent
.CIDS	Without Topcoat	Not Recommended	Not Recommended	Good
	With Recommended Topcoat	Not Recommended	Very Good	Excellent
.LKALIES	Without Topcoat	Not Recommended	Not Recommended	Fair
	With Recommended Topcoat	Not Recommended	Very Good	Excellent

	Class A	Class B		Class C
:ECOMMENDED OPCOATS OVER :ARBO ZINC 11	Carboline 188 HB, 190 HB, 190 HBW, 191, 3912. Carbomastic #14	All of Class A. Phenoline 305, Polyclad 936-1, 2 c. Carboline 3630.	Polyclad 935 Tie Coat plus topcoats of Carboline 1294 or Polyclad 936-1	All of Class A and B. Versikote 53, Carboline 330 4631, 4674, 4

OUTSTANDING PROPERTIES OF CARBO ZINC 11

:er insoluble 20 minutes after application.

be placed in immersion service within 6 hours.

olication can be made at 0° F and on surfaces as hot 00° F.

curing solutions are required.

vents sub-film corrosion. Protects galvanically.

be applied at thicknesses up to 6 mils per coat hout danger of "mudcracking" or loss of adhesion.

7. In chemical and coastal areas has longer life expecta than heavy galvanizing.
8. Unnecessary to neutralize, wash or scrub surface prio topcoating.
9. Carbo Zinc 11 Gray does not contain lead or lead c pounds.
10. Carbo Zinc 11 Gray and Carbo Zinc 11 Food Grade a non-toxic and can be used in food plants for immers and non-immersion service.

ION: Tank linings may be cleaned with steam, water or mild detergent solutions. Do not use acids or alkalies.

carboline

PRODUCT DATA SHEET

CARBOLINE 190 H

SELECTION DATA

ENERIC TYPE: Epoxy-polyamide. Catalyst (curing ent) added prior to application.

ENERAL PROPERTIES: A high build coating having xcellent resistance to salts, water, alkalies and weathering. as very good resistance to mild fumes of acids and sol- nts. The cured film is tough and abrasion resistant. Can applied at thicknesses of 4 – 6 mils in one coat. Applica- on properties are excellent. Has a low cost per mil foot.

ECOMMENDED USES: Carboline 190 HB is used idely as a topcoat directly over Carbo Zinc 11 for ex- osures to salt, alkalies, water and weathering. Also used ver hot dipped galvanizing and other inorganic zinc oatings as recommended. Specific uses include offshore illing structures above and below waterline, ship and arge exteriors, coastal installations. Also for protection of ructural steel and equipment in chemical plants, pulp ills, water and sewage plants, refineries and many other dustries.

OT RECOMMENDED FOR: Strong acid exposures.

HEMICAL RESISTANCE GUIDE:

Exposure	Splash and Heavy Fumes	Mild Fumes
Acids	Fair	Very Good
Alkalies	Excellent	Excellent
Solvents	Good	Very Good
Salts	Excellent	Excellent
Water	Excellent	Excellent

EMPERATURE RESISTANCE:

Continuous	200°F
Non-continuous	275°F

LEXIBILITY: Good

WEATHERING: Good

BRASION RESISTANCE: Very Good

URFACES: Carbo Zinc 11, hot dipped galvanizing, or ther suitably primed surfaces.

OPCOAT REQUIRED: None. May be topcoated with arboline 1294 to upgrade weathering resistance, or for igher gloss.

OMPATIBILITY WITH OTHER COATINGS: May be plied directly over Carbo Zinc 11, catalyzed epoxies, or

SPECIFICATION DATA

SOLIDS CONTENT:	By Weight	By Volu
Carboline 190 HB	76% ± 2%	58% ± 1

FILM THICKNESS PER COAT: 4 – 6 mils

THEORETICAL YIELD: 930 mil ft./gal. of mix

THEORETICAL COVERAGE*
PER GALLON OF MIX:
233 sq. ft. – 4 mils
155 sq. ft. – 6 mils

*NOTE: Material losses during mixing and applica will vary and must be taken into consideration when mating job requirements.

SURFACE PREPARATION: Surface must be clean dry. No pre-treatment of hot dipped galvanizing is neces except for removal of oil, grease, dirt, and other contam tion.

COLORS: Stocked standard colors are White, Gray 7 724 and Yellow 627. Other colors available on spe order and are not returnable. If a light color, particul white, is to be used over dark coatings, including fi Carbo Zinc 11, more than one coat may be required obtain uniform hiding.

GLOSS: Flat.

APPLICATION DATA

METHOD OF APPLICATION: Airless and conventic spray. Brushing may be used for small work, or touch

GUNS:	Fluid Tip	Air Cap
Conventional Spray		
Binks #18 or #19	66	66 PE
DeVilbiss P-MBC, or JGA	E	704
Airless Spray		
Graco	.021" orifice and 2200 psi.	

MIXING RATIO: (By volume):
Carboline 190 HB Component A 1 gallon

DRYING TIME BETWEEN COATS:
18 hours @75°F, or
10 hours @90°F

FINAL DRYING TIME: 2 days @75°F

SHELF LIFE:
18 months

POT LIFE:
8 hours @75°F

THINNER USED: Carboline Thinner #15. For hot and/or windy conditions, use Carboline Thinner #33. (Up to 1 quart per gallon.)

ORDERING INFORMATION

COST PER GALLON: FOB Xenia, Ohio Net 30 days

	2's	10's
Carboline 190 HB Black	$9.30 Net	$8.20 Net
Carboline 190 HB White, Gray 720, Gray 724	9.95 Net	8.85 Net
Carboline 190 HB Yellow 627	10.55 Net	9.45 Net
Carboline Thinner #15	2.90 Net (1's)	2.35 Net (5's)
Carboline Thinner #33	3.20 Net (1's)	2.65 Net (5's)

THEORETICAL COST PER MIL FOOT:
0.88¢ (Black)
0.95¢ (Gray)

THEORETICAL COST PER SQ. FT.:

	4 mils	6 m
Carboline 190 HB Black	3.52¢	5.3
Carboline 190 HB Gray	3.8¢	5.7

SHIPPING WEIGHT:

	2's	10's
Carboline 190 HB	27 lbs.	132
Carboline Thinner #15	9 lbs. (1's)	45 lbs.
Carboline Thinner #33	9 lbs. (1's)	45 lbs.

FLASH POINT: (Cleveland Open Cup)

Carboline 190 HB Component A	170°F
Carboline 190 HB Component B	130°F
Carboline Thinner #15	93°F
Carboline Thinner #33	140°F

Product Data Sheet

Before using this product, read the GENERAL INSTRUCTIONS FOR DEVRAN® COATINGS and the appropriate DEVRAN® SYSTEM BULLETIN.

FORMULA 201 DEVRAN

EXTERIOR PRIMER

TYPE	Solution Epoxy
PACKAGING	Two components supplied as a kit; Available in 5-gal. or 1-gal. kits
COMPONENT RATIOS Field Mixing	BASE to CONVERTOR 4-1/2 gal. 1/2 gal. or 9/10 gal. 1/10 gal.
PRE-MIX TIME	None
POT LIFE	24 Hours at 77°F.
DRY-TO-RECOAT TIME	2 hours minimum at 68°F (20°C) under good conditions
FLASH POINT	Over 80°F. Tag Open Cup
SOLVENT	MD-1931 DEVRAN® All Purpose Thinner
GLOSS	Flat
DRY FILM THICKNESS	2.0 mils

COLORS:	BUFF	LT. GREEN	GRAY	WHITE	DAI
Base Catalog No. Color	MD-1936 Cream	MD-1936 Cream	MD-1936 Cream	MD-2786 White	MD- Cre.
Converter Catalog No. Color	MD-1938 Red	MD-1937 Green	MD-1939 Gray	MD-2787 White	MD- Bla
SPREADING RATE (theor. sq. ft./gal.)	361	361	361	359	361
WET FILM THICKNESS (in mils)	4.3	4.3	4.3	4.3	4.3
SQ. FT. PER GAL. @ 1 MIL DRY FILM	723	723	723	718	723
NET WEIGHT PER GALLON (in lbs.)	11.0	11.1	11.0	11.0	10.9
WT PER SQ. FT. @ 1 MIL DRY FILM (lbs)	.010	.010	.010	.010	.01C

roduct Data Sheet

CATHA-COAT FORMULA 302

re using this product, read the GENERAL TRUCTIONS FOR DEVRAN COATINGS and appropriate DEVRAN SYSTEM BULLETIN.

TYPE	Modified inorganic zinc self curing, plus excellent recoatability		
PACKAGING	In 1-gal. piggy-back kits (with zinc powder in paste form, merely stir in Reducer or mix on mechanical shaker)		
COMPONENT RATIOS Field Mixing	**PASTE** 4/5 gal.	to	**REDUCER** 1/5 gal.
PRE-MIX TIME	None		
POT LIFE	24 hours at 77° F.		
DRY TO TOUCH	1/2 hour min. at 68°F (20°C) under good conditions		
DRY TO RECOAT TIME	4 hours min. at 68°F (20°C) under good conditions		
FLASH POINT	Over 80° F. Pensky-Martens Closed Cup		
SOLVENT	MD-1931 DEVRAN All Purpose Thinner		
GLOSS	Flat		
WET FILM THICKNESS (in mils)	7-8		
DRY FILM THICKNESS	3.0 (minimum)		

COLORS	GREEN	BROWN	DARK GRAY
Paste: Catalog No.	MD-3062	MD-2860	MD-2855
Color	Green	Brown	DARK GRAY
Reducer: Catalog No.	MD-3063	MD-3063	MD-3063
Color	Clear	Clear	Clear
SPREADING RATE (Est. Prac. Sq. Ft./Gal.)	200	200	200

CATHA-COAT® FORMULA 302

MODIFIED INORGANIC ZINC – SELF CURING – PLUS EXCELLENT RECOATABILITY

TYPE

Catha-Coat Formula 302 is a modified inorganic zinc coating, self curing, which is extremely effective in preventing corrosion attack on ferrous metal surfaces. Due to its high zinc content, Catha-Coat Formula 302 provides effective cathodic protection to the steel surface to which it is applied, and at the same time contains excellent recoating properties not found with self curing 100% inorganic zincs. One of the special features of Catha-Coat® 302 is that it can be overcoated, without using a primer, with a high performance top coat such as DEVRAN® 209 or 219. It may also be overcoated with itself or with DEVRAN® Primers (201, 202, 208, etc.) Overcoating with Conventional Paints can be accomplished by the use of an intermediate coat of either Zinc Seal (MD2953) for alkyd or oil based paints or Wash Primer (MD881) for vinyls or vinyl-alkyd based paints.

COLORS

BROWN GREEN GRAY

PACKAGING

One gallon piggy-back cans. Zinc is ready-mixed in paste form, merely thin down by mixing in reducer which is in small can on top.

USES

For use in a single application or with top coats on offshore oil structures, steel hulls, decks, barges or similar surfaces offering:

1. True Cathodic protection
2. Ease of application (similar to good organic coatings)
3. Mostly inorganic binder

SURFACE PREPARATION

All surfaces to be coated shall receive a Near White Blast Cleaning. This shall be at least equivalent to SSPC-SP 10-63T Near White Blast Cleaning (as defined by the Steel Structures Painting Council, 4400 Fifth Avenue, Pittsburgh, Pennsylvania).

APPLICATION

Catha-Coat 302 can be applied with all types of application equipment from roller to airless spray. For spray application, be sure that equipment is set up so that both fluid pressure and atomization air pressure can be independently regulated. A valuable point to remember is that the fluid pressure requirement for Catha-Coat 302 is lower than for other products. Excessively high fluid pressure will cause pock marks and/or pin holes in the film.

(over)

FILM THICKNESS

A minimum dry film thickness of 3.0 mils should be applied.

The ease of application of Catha-Coat® 302 combined with its excellent hiding capabilities tend to cause the applicator to apply a film of less than the required mil thickness. In order to achieve the proper dry film thickness, Catha-Coat 302 must be applied at a wet film thickness of 7–8 mils. This can be readily accomplished by providing the applicators with a "Wet Film Gauge", similar to the one manufactured by the Nordson Company.

When applied at 3–4 mils dry Catha-Coat 302 exceeds the requirements for zinc coated metal per American Society Testing Materials (A.S.T.M.) Specification A93–59T.

SPREADING RATE

The practical spreading rate allowing for normal losses is approximately 200 square feet per gallon which will yield a minimum dry film thickness of 3.0 mils.

REDUCTION & MIXING

Regardless of the method of application, Catha-Coat®302 should be mixed in the exact proportion in which the components are supplied (1/5 gallon of Catha-Coat® Reducer to 4/5 gallons of Paste). Care should be taken to be sure material is thoroughly mixed. Mixture should be "boxed" from one container to another. An agitated spray pot is helpful. DEVRAN® Thinner should be used for cleaning up equipment. Equipment should be cleaned within one hour after application has stopped.

IMPORTANT

Do not thin mixed material. The solution may appear heavy but application is not affected. It is also very important that the mixture of Catha-Coat® Formula 302 Paste and Reducer be thoroughly stirred before application is resumed. In a reduced state, this material has a tendency to settle. Please consult the Catha-Coat® 302 Product Data Sheet for additional information.

WARNING

Catha-Coat®302 is not toxic in the ordinary sense of the word, but precautions have to be taken in handling. This product contains alkali silicates which are irritating to eyes and skin. Avoid splashing into eyes or contact with skin. In case of such contact, flood eyes repeatedly with water and call physician immediately. Wash thoroughly after handling and before smoking and eating. Do not take internally. Product is combustible. Keep away from heat and open flame. Close container after each use. Keep out of reach of children.

NOTICE

The facts stated and the recommendations made about these products are based on our research and the research of others and are believed to be accurate. No guarantee of their accuracy is made, however, and the products discussed are distributed without warranty, expressed or implied, and upon condition that recipients shall make their own tests to determine the suitability of such products for their particular purpose.

METCO®

PLASMA COATINGS FOR EXCEPTIONAL WEAR RESISTANCE

COATING PROPERTIES

Coatings	SURFACE FINISH			HARDNESS			OTHER PROPERTIES		
	Texture As-Sprayed AA	Texture Ground AA	Texture Lapped AA	Macrohardness (Rc)	Cross Sectional Hardness (DPH$_{300}$)	Particle Hardness (Knoop)	Density (g/cc)	Porosity	Maximum Service in Oxidizing Atmosphere
ngsten Carbide									
72F-NS	250-350	7-8 [1]	1-3	55-60	N/A [5]	Rc 75 Equiv. [9]	14.5	2%	1000°F
74F-NS	250-350	12-18 [4] 7-10 [1]	3-6	47-52	N/A	N/A	12.3	5%	1000°F
74SF	90-110	10-20 [2] 7-8 [1]	1-1½	50-53	650	N/A	14.5	1/2%	1000°F
439	200	6-14 [1]	2-4	46-50	N/A	960 (Rc60) [7] 1500 (Rc70) [8] 2400 (Rc80) [9]	9.5	5%	1200°F
)xide Ceramic									
105SF 3	50-200 [11]	14-20 [3] 15-25 [4]	2-4	62-69	810-900	N/A	3.4	1/2%	N/A
131VF	100-400 [11]	71 [3] 6 [1]	2	61	850	850 [6]	3.5	1%	1000°F
romium Carbide									
81VF-NS	200-350 [11]	12-25 [2]	2-4	50-54	550-720 [11]	N/A	6.2	N/A	1500°F

NOTE
[1] [2] [3] [4] [5] [6] [7] [8] [9] [10] [11]

ions of selected grades of carbide produces very high deposit efficiencies. Hardness of the matrix in such coatings is RC 62-66 while the carbide is the equivalent of RC 75.

These powders are recommended for application where abrasion conditions are severe.

Oxidation resistant alloys

These alloys were developed primarily on the basis of their oxidation resistance and then processed to meet the requirements of the ThermoSpray process. They are not self-fluxing and are always used in the "as-sprayed" state. In many cases they are used as bonding or barrier coatings where a ceramic will subsequently be applied.

Ceramics

The high thermal efficiency of the ThermoSpray gun makes it possible to apply refractory materials at speeds which are economically feasible. Many special purpose refractory and cermet coatings may be sprayed, but alumina and zirconia are the materials most widely used.

ThermoSpray Powder 101, a grey alumina containing titania and traces of other oxides which tend to "toughen" the grain. This material is used for wear-resistant coatings and for heat resistance where wear and abrasion are also present.

ThermoSpray Powder 105 — a high purity white alumina having lower emissivity and lower thermal conductivity than No. 101. Preferred for its thermal properties in heat barriers, particularly where blast erosion is a factor. Also used as a high temperature dielectric although sealing is required if dielectric strength is to remain constant.

ThermoSpray Powder 201 — lime-stabilized zirconia used for heat insulation. Melting point approx. 4650 F. Color — light yellow. Abrasion resistance fair, though lower than that of ThermoSpray 101 or 105.

TYPE ANALYSIS OF METCO FLAME SPRAY POWD

METCO Flame Spray Powders	Tungsten Carbide Cobalt Aggregate	Iron	Nickel	Chromium	Carbon	Silicon	Boron	Copper	Molyb denum
For Wear Coatings									
12C	–	2.5	Bal	10.	.15	2.5	2.5	–	–
14E–14F	–	4.	Bal	14.	.6	3.5	2.75	–	–
15E*-15F*	–	4.	Bal	17.	1.	4.	3.5	–	–
16C**††	–	2.5	Bal	16.	.5	4.	4.	3.	3.
18C	–	2.5	Bal	18.	.2	3.5	3.	–	6.
31C	35.	2.5	46.	11.	.5	2.5	2.5	–	–
32C	80.	.8	14.	3.5	.1	.8	.8	–	–
34F-34FP	50.	3.5	33.	9.	.5	2.	2.	–	–
METCO Metallic Self-Bonding Powders									
404*	–	–	80.	–	–	–	–	–	–
439*	50.	1.5	Bal	6.	.5	1.5	1.	–	–
450†	–	–	Bal	–	–	–	–	–	–
451†	–	–	Bal	9.5	–	2.5	1.5	–	–
METCO Metallic Alloys and Mixtures generally used "as Sprayed"									
41C	–	Bal	12.	17.	.1	1.	–	–	2.5
42C	–	Bal	2.	16.	.2	–	–	–	–
43C, 43CNS	–	–	80.	20.	–	–	–	–	–
43F, 43F-NS	–	–	80.	20.	–	–	–	–	–
54	–	–	–	–	–	–	–	–	–
55	–	–	–	–	–	–	–	99.0+	–
56F-NS	–	–	99.3	–	–	–	–	–	–
63	–	–	–	–	–	–	–	–	99
63-NS	–	–	–	–	–	–	–	–	99
70C-NS	–	–	–	–	–	–	–	–	–
71-NS	Bal	1.	–	–	4	–	–	–	–
80-NS	–	–	12.	3.	–	–	–	–	–
81-NS	–	–	20.	5.	–	–	–	–	–

TYPE ANALYSIS OF METCO CERAMIC POWDER

METCO Ceramic Powders	Aluminum Oxide	Zirconium Oxide	Titanium Dioxide	Calcium Oxide	Silicon Dioxide	Iron Oxide	Mix C
101-NS	Bal	–	2.5	–	–	–	
102	–	–	99.0*	–	–	–	
105-NS	98.0*	–	–	–	–	–	
106-NS	–	–	–	–	–	–	
110	50	–	50.	–	–	–	
201, B-NS, NS	.5	93	–	5.	.4	–	
210	–	Bal	–	–	–	–	
211	–	Bal	–	31.	–	–	
METCO Cermet Powders							
410*	70% METCO 101–30% METCO 404						
411*	30% METCO 101–70% METCO 404						
412*	65% METCO 201–35% METCO 404						
413*	35% METCO 201–65% METCO 404						

*Patent Pending
**Not Serviceable AMS 4775 in Many Applications
††18C Covered by U.S. Pat. No. 2,875,043

typical applications

The ThermoSpray process has found wide application wherever service conditions are severe as, for example, in equipment for the petroleum and chemical industries. In the former it has been used with notable success on pump-plungers used in oil well pumping units and in pumps used in "water-flooding" which injects water into partially depleted oil pools to force out the remaining oil. Both the crude oil and salt water used in secondary recovery projects contain highly corrosive chemicals which would ruin ordinary metals in a short time. The ThermoSpray facings not only are highly corrosion resistant, but are also highly resistant to abrasion encou such service. The plungers range in size fr inches in diameter, 10 to 30 inches in leng ThermoSpray Powder 15C or 16C is gener on this type of part.

Dry "Fluid" Drive

Dodge Manufacturing Company produces dry "fluid" drive called Flexidyne. Instea usual fluid this device uses steel shot, which

QUELAQUA

QUELAQUA raises water off wet metal to coat the entire metal surface with an economical, long-lasting film.

PHYSICAL PROPERTIES

Flash Point	100°F.	Specific Gravity	0.85
Heat Resistance	up to 400°F.	Weight/gal.	6.9 lbs.
Film Thickness	0.0003"	30 days @ 100% Rel. Humidity	no change

QUELAQUA meets Specifications - MIL C-16173C, GR 3, and MIL C-14201A, Gr 2

For Use on Wet Metal:

QUELAQUA is a polar type water displacing product available in bulk or in 16-ounce aerosol package. QUELAQUA takes advantage of low surface tension to preferentially wet the metal surface and creep as a continuous film under the mositure layer. QUELAQUA can be used with many combinations of ferrous and non-ferrous metals.

Economical:

Because of great capillary action, a small amount of QUELAQUA spreads out and covers a large surface area. As much as 5,000 square feet will be covered by one gallon.

Protection is Long Lasting:

QUELAQUA contains an anti-oxidant additive and will not break down and cause metal corrosion.

Oil Soluble:

QUELAQUA does not have to be removed before lubricating inasmuch as it is compatible with mineral lubricants. If necessary, it can be removed with solvents or degreaser.

Application:

QUELAQUA may be applied by spray, dip or brush. It may be easily removed by petroleum solvent, vapor degreaser or alkaline cleaners. Available in bulk and one-pound handy aerosol cans.

Where to Use:

Maintenance	Manufacturing	Communications
Motors & Generators	Pre-assembly Storage	Telephone
Controls & Switches	Protection During Shipment	Radio & Television
Batteries, Chargers	Temporary Protection Over-night Assembly Line	Sound Components
Relays		Marine & Airborne Radios
Refrigeration		
Printed Circuitry		

QUELAQUA

- Displaces water on wet surfaces
- Excellent coverage per gallon
- No damage to bimetallic systems
- Long lasting film
- Miscible with lubricants

Bulletin 39-869

QUELCOR Plastisol Number	Pounds Per Gallon	Viscosity 4RPM-23°C CPS.	Shore A Durometer	Tensile Strength lbs/sq. inch	Percent Elongation At Break	Graves Tear Strength lbs/inch	Application Method	Character-istics	USES
1017	10.5	5000	70-75	2100	325	-	HD, M	1,5,8	Tool Handles, Clips, Brackets, Wire Goods, Gloves
→1075	9.8	4000	67-70	2100	300	350	HD, M,RC,FC	1, 5	Mil Spec Navy Shipboard - Shore Installation Items
1093	10.7	8000	80-85	2200	275	300	HD, M	1,2,5,6	Pipe, Tank Linings, Floor Grating, Fume Stacks,Hoods Structu 15 years' exposure experience.
1094	10.7	6000	90-95	3100	250	550	HD, M	1,2,5,6	Electroplating Racks.
1095	10.2	3500	70-75	1800	350	-	HD, M	1,4,5	Color Coding Communications Equipment, Varistors, etc.
1096	10.6	5000	90	2850	260	450	HD, M	1,2,3,5,6	Electrical Equipment for Utilities.
1097	10.7	3000	80-85	2200	300	300	HD, M, K	1,2,5,6	Rotational Pipe Linings.
1211	10.0	5000	70-75	2300	300	350	HD, M, RC, FC.	10	Glassware, Aerosol Bottles, Gauges,Embedding Wire Slings.
1409	11.0	7000	60-65	1700	400	225	HD, M, 1	2,3,4,5,6,	Automotive Applications-Ignition Harness, Light Sockets, Brackets.
1410	9.8	-	30	--	--	--	M	2,12	Printing Rolls. Same as 1409, but low durometer.
1416	10.3	4000	90.	2850	250	500	HD, M, RC	1,2,3,4,5,6,7	Utility Uses: Crab Connectors, Pigtail Connector,Tool Handle
2012	10.0	4000	95+	3000	270	--	M	1,2,3,6	Roll Covering, Moulding Rigid PVC Items.
2100	11.0	8000	70	1500	325	150	M,RC	3,7,8	Automotive Air Filters.
2210	11.2	2500	65	1300	300	--	M,RC	8	Low Cost Filled Plastisol for Dolls, Toys, Display Items.
3612	10.5	2500	95+	3500	160	450	SA,SC	1,2,3,4,5,6,	Thin Film - Drum, Can Linings, Strip Metal Coatings.
4282	10.2	25000@ 20RPM 175000@2 RPM	80-85	1900	225	325	SA	1,2,5,6	40-70 Mils Per Coat - Tank Linings, Hoods, Items too Large f dipping.
4515							SA	5,9	Foams on curing; packaging spare parts for shipment, storage sound deadening, insulation
5200	10.0	29000@20 RPM	95	3000	275	500	SA	1,2,5,6,13	Pipe Covering, Pilings, Highway Guardrails
7100	10.5	1500	30	1000	500	--	HM	3,12	Hot Melt for pouring or Knifing; Adhesives, Encapsulation, reusable moulds
7508	9.5-10.0	1000-5000	10-50	350-1500	400-600	--	M,RC	12	Cushions, Gaskets
9000 SERIES	REPAIR PUTTIES -- BASED ON FORMULATIONS SUCH AS 1017, 1075, 1093, 4282								Thixotropic Plastisol Putties for Patching.
103 M	PLASTISOL PRIMER FOR ADHESION OF ALL PLASTISOLS TO METALS, GLASS, MOST PLASTICS								

CHARACTERISTICS:

APPLICATION METHOD:

COMPOUND

SPRAYLAT SC-1074B-1 is a sprayable, strippable coating formulated for the following uses:

1. Protection of all surfaces (plastic, metal, porcelain, paint - both enamel and lacquer).
2. Mask against paint overspray on all surfaces.
3. Protection of equipment in storage and transportation used alone or with Spraylat SC-1090 as a top coat. Meets Military Preservation Coating Specification MIL-C-6799E, Type II, Class 1.

APPLICATION: Using standard good atomizing spray equipment (e.g. DeVilbiss MBC gun, FF nozzle and #765 air cap) with pressure feed, a 4 mil (.004") film can be applied to a vertical surface in one coat. Atomization pressure of 75 pounds per square inch and sufficient pot pressure (5 pounds per square inch) to obtain proper fluid delivery is recommended. Airless spray can also be used such as a Graco #205-904 with a 163-618 insert and a 28:1 ratio pump. Use water only for cleaning spray equipment.

Drying can be accelerated by circulation of warm air or infra-red lamps.

SPECIAL INSTRUCTIONS

When spraying over freshly lacquered or enameled surfaces, allow 24 hours for lacquer to dry and allow full enamel cure before using Spraylat SC-1074B-1. Be sure to apply full film thickness of 4 mils. On equipment to be stored for many months exposed to rain, sun and snow, we recommend that an 8 mil (.008") film of Spraylat SC-1074B-1 be applied in two coats, drying one hour between coats. After the film has dried enough to lose its gloss, it should then be overcoated with Spraylat SC-1090 to a thickness of 2 mils (.002").

NOTE: This is a water base compound and should be protected from freezing. Recommended storage temperature is 55° to 90°F.

SPRAYLAT

TYPE: Water Disp

COLOR: Black

NON-VOLATI 43 to 44%

DENSITY: 8.6 lbs. p

TOXICITY: Non-toxic

TENSILE ST 2900 lbs.

ELONGATION 200%

FLAMMABILI Non-flamma

COVERAGE: Approximat sq. ft. pe per 4 mil

See Preser Manual fo detailed instructi

COMPOUND

SPRAYLAT

SPRAYLAT SC-1090 is a water-based top coating designed to be used in conjunction with Spraylat SC-1074B-1 to form a perservation system for shipment and storage. It meets MIL-C-6799E, Type II, Class 5.

Spraylat SC-1090 reduces the elapsed time required in applying the preservation system. Spraylat SC-1076-1 (caulking) and Spraylat SC-1074B-1 (black base coat) are applied in the usual fashion. After applying the second coat of SC-1074B-1, the SC-1090 can immediately be applied over the wet SC-1074B-1. The SC-1090 has the ability to dry rapidly to a rain resistant coating and, at the same time, allow the SC-1074B-1 to dry beneath it.

Under conditions of 50% Relative Humidity and 70°F, about two hours drying time provides a rain resistant coating. In direct sunlight or with high air circulation and warm temperatures the drying time is even less. In conditions of high relative humidity, the time required for the top coat to dry is, of course, longer. Items, such as aircraft, may be dried outdoors as long as there is no direct rain on the preserved item and temperatures are above 32°F.

APPLICATION: Temperatures at time of application and drying should be over 35° to 40°F. The SC-1090 should be applied in two separate coats, using air or airless equipment. Equipment recommended is Graco President or Bulldog Model Pump with 205-591 Gun and standard tip with orifice of between .011 and .021 and angle between 40° and 60°. (Tip #163-617 recommended). The first coat should be a dry coat applied with a wide fan and the gun held about 18" from the surface. This discontinuous dry coat should barely cover the black SC-1074B-1 and will minimize bubbles in the film. The second coat should be a normal spray application to build to the required 2 to 3 mils of dry film.

COLOR:
White

SOLIDS:
48 ± 1%

DENSITY:
9.3 lbs.

VISCOSITY
60 KU

DRYING TI
At 50% Re
Humidity
SC-1090 o
SC-1074B-
2 hours t
resistant

COVERAGE:
200 sq. f
gallon fo
film.

FLAMMABIL
Non-flamm

TOUCH-UP
Pinholes
should be
using SC-
Brushable

2NO-NAEC-2455(REV. 2-68)
PLATE NO. 11963

APP. K-12

B-2

COMPOU

COVERLAC SC

COVERLAC SC 270 is a specially formulated spray-on strip-off coating for the outdoor protection of aluminum stainless steel and steel. A slightly modified formula designated COVERLAC SC 270A is used for copper alloys.

These plastic coatings will protect these surfaces from oxidation, scratches, paint and attack by mortar or cement. They are being used in the construction industry for protection during shipment and erection of curtain walls, doors, window frames, spandrels and paneling. They are also being used to protect bare steel surfaces such as stamping dies in outdoor storage.

The compounds are easily applied and are unique in their excellent outdoor aging characteristics. Films of COVERLAC SC 270 applied to 5 mils thickness have been outdoors for periods up to two years and were still flexible and easily peelable from the surface.

APPLICATION: COVERLAC SC 270 and SC 270A are easily applied using pressure type spray equipment. An example of such equipment is a De Vilbiss MBC gun, FX fluid nozzle and No. 765 air cap. Atomization pressure of 75 to 90 PSI and sufficient pot pressure to get a proper spray pattern should be used.

A smooth dense coating of 5± 1 mils (.004" - .006") can be applied in one box coat. The first pass should be a thin continuous coat and the second pass (30 second interval) should deposit sufficient compound for the recommended film thickness.

The compounds should be stirred before using and sprayed as received.

For cleaning equipment, use COVERLAC THINNER SC 211

COLOR: Grey

SOLIDS: 27%

VISCOSITY: 20 seconds (#4 Ford Cup)

DENSITY: 7.4

pounds per ga

TENSILE STRENGTH: 1300 PSI

ELONGATION: 150%

DRYING TIME: Tack Free - 10 Min.

Full Hardness 12 Hrs.

ADHESION:

Aluminum - 0.
pounds per inch

COMBUSTIBIL

Film is non-combustible

COVERAGE: 60 sq. ft. per gallon for 5 mil film.

Thermo Cote inc.

STRIPPABLE
PROTECTIVE
COATINGS

DE 201 • ARMORY 8-2000

798 21ST AVENUE • PATERSON, NEW JERSEY 07513

THERMO-COTE N-4 (55)

NEW PLATING MASK COMPOUND

For Clean Sharp Distinct "Stop-Off" Lines

Manufacturer's Certification of Equal Product

O COTE N-4 (55), compound wax electroplating stop-off material.

Material:
Compound furnished is 100% solids hot melt coating, based on Cellulose Acetate Butyrate, and combined with various plasticizers and stabilizers. The compound is designed for masking parts to be plated and is suitable for use in chromium, copper, bright nickel, cadmium, and the other common acid and alkaline plating solutions, without causing solution contamination.

Odor:
A characteristic butyric odor.

Stability:
The compound has an indefinite storage life. At 350° F. the compound has a minimum useful life of 300 hours.

Physical Requirements:
The compound conforms to the following physical properties; Fire point - Cleveland open cup - 430° F. min. Tensile strength - 1400 # per square inch minimum.

Toxicity:
The compound contains no ingredients which may be injurious to persons using it

Corrosion:
The compound will not produce corrosive effects on metals as brass, lead, steel and zinc.

Time for set:
A sample of the compound heated to 350° F. will set to a consistency suitable for use after cooling in 78° F. air for five (5) Minutes.

Color:
The compound after being applied to parts and after cooling will be transparen

Operating Temperature:
Operating Temperature is 350° F. plus or minimum 25° F.

Re-use:

The used compound after rinsing in an alkaline solution, rinsing in clear w. and finally drying, will be suitable for re-use without danger of contamina of the plating solutions.

Adhesion:
The compound will adhere to clean metal so that after the masked part is tr: back no solution will seep or run under the trimmed edge. The compound aft cutting with a knife will be easily removed by stripping or peeling.

Recommendations for Use

THERMO COTE N-4 (55) should be used in a molten state at 350° F. A thermo-tically controlled melt tank is recommended.

The object to be masked should be clean and ready for plating. It is then pped momentarily into THERMO COTE N-4 (55). The resultant coating will dry with seconds. The coating can then be cut to the "Stop-Off" line or lines desired. sharp knife or razor edge is the most satisfactory.)

The object is now ready to be plated.

After the plating operation is completed, the coating is removed by simply eling it, or pulling it off like a glove.

THERMO COTE N-4 (55) is 100% re-usable. Used coatings need simply to be ri and dried and can then be re-melted.

THERMO COTE N-4 (55) is suited for all types of common plating solutions, i ading: Chromium, Nickel, Cadmium, and Copper.

ITE TODAY: For assistance in your particular masking operations. You are assu of our prompt attention.

Thermo Cote inc.

STRIPPA
PROTECT
COATIN

CODE 201 • ARMORY 8-2000

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BRIEF DESCRIPTION OF THERMO-COTE COMPOUNDS AND CLIDERITE

HERMO-COTE D
Use at 340° - 350° F.
The basic low-cost protective coating. Very inexpen light-transparent color. Practically no funes nor c during use.

HERMO-COTE I
Use at 350° - 375° F.
Meets Specification Jan-C-149, Type I. Light amber color and similar to Thermo-Cote D.

HERMO-COTE 149
Use at 320° - 340° F.
Meets Specification Jan-C-149 (MIL-C-149) Type II. Water-white, transparent. Excellent stability on he This is the compound widely used in the aircraft ind and in Government installations.

HERMO-COTE 149A-11
Use at 320° - 340° F.
Meets Specification MIL-P-149A, Type II. Light, tra parent coating, oil exuding. Gives maximum protecti within a temperature range of 65° below zero to 100° above zero, Farenheit, at 100% relative humidity.

HERMO-COTE N-4
Use at 350° F.
A quality, water-clear compound that does not develo oily surface. Of special interest as a masking comp for plating and other applications requiring no oil exudation.

HERMO-COTE N-4 (55)
Identical material to N-4 with the exception of its having a pink, transparent dye which facilitates cut or stop-off lines in masking and plating.

LIDERITE
Use at 350° F.
A thermoplastic potting compound that sets into a ha tough material, offers excellent electrical insulati properties and moisture and shock protection to the enclosed parts.

ROTEXO-COTE V-12
Use at room temp.
A vinyl base, solvent type liquid. For brush, spray cold dip application to metal, glass, ceramics, etc. Ready to use from can, or may be thinned with V-12 solvent blend thinner.

PECIAL FORMULATIONS can be made by our engineering department to meet your requirements.

Send full details

COATING
CODE 201 ● ARMORY 8-2000
798 21ST AVENUE ● PATERSON, NEW JERSEY 07513

TYPICAL SPECIFICATIONS FOR THERMO-COTE PRODUCTS

SPECIFICATION TEST	TYPE D	TYPE I	TYPES II&IIA	TYPES N-4&N-55	CLIDERI
Solid					
Clarity	Clear	Clear	Clear	Clear	Opaque
Foreign Matter[1]	1-2 Specs	1-2 Specs	1-2 Specs	1-2 Specs	None**
Oil Film	Slight	Slight	Slight	None	None
Color No.*	#8 max.	#10 max.	#5 max.	#3 max. N-4	Off-whi
Initial Melt					
Clarity	Clear	Clear	Clear	Clear	Clear
Foreign Matter[2]	1-2 Specs	1-2 Specs	1-2 Specs	1-2 Specs	1-2 Spe
Initial Film					
Clarity	Clear	Clear	Clear	Clear	Opaque
Foreign Matter[3]	1 Spec	1 Spec	1 Spec	1 Spec	1 Spec
Oil Film	Slight	Slight	Slight	None	None
Thickness"	0.100±.005	0.100±.005	0.85±.010	0.100±.010	0.090±.
Exudation					
%Loss, 24hrs./160°F	2.0 min. 5.0 max.	1.0 min. 5.0 max.	2.0 min. 4.0 max.	0.5% max.	0.5% ma
Plasticity					
Thickness"/compress	0.100±.010	0.100±.010	0.35±.05	0.40±0.05	(not de
Aged Melt					
Clarity	Clear	Clear	Clear	Clear	(not de
Homo.	No Sep.	No Sep.	No Sep.	No Sep.	(not de
Color	#15 max.	#18 max.	#8 max.	#5 max.	(not de
Aged Film					
Strip, Flex.	Easily no crack	Easily no crack	Easily no crack	Sl.Difficult no crack	(not de (not de

[1]per block 3" x 5" x ½"
[2]per 50 cc melt
[3]per film 2" x 3" x 0.1"

* Hellige Color comparator
** On surface

Thermo Cote inc.
PROTECTIVE COATINGS
DE 201 ● ARMORY 8-2000
788 21ST AVENUE ● PATERSON, NEW JERSEY 07513

PROTEXO-COTE V-12

STRIPPABLE PROTECTIVE COATING
(Brush or Spray or Cold Dip Application)

PROTEXO-COTE V-12 is a vinyl base - solvent type liquid, designed for easily applie interim protection of all types of metal, ceramic, glass, and other surfaces. This tough Protexo-Cote V-12 coating protects the surface from such hazards as scratches, rust, abrasion, dirt, corrosion, and yet is is easily stripped off when the clean surface is needed.

Protexo-Cote V-12 brings the advantages of interim surface protection to large or unusually shaped objects that cannot be protected by our Thermo-Cote hot melt protective coatings, which must be applied by dipping the object. Since Protexo-Cote V-12 is applied by brush or spray, it can be used on large sheets, big equipment, long objects, or any other surface it's possible to reach with a paint brush.

This tough, flexible Protexo-Cote film is easily removed when the need for protection is over, by merely lifting one corner of the film and peeling the film off the object. Because of its strength and elasticity, the film usually is stripped off in one sheet.

SUGGESTED USES FOR PROTEXO-COTE V-12

* Protection of polished metal sheets and shapes during fabrication, shipping, storage or installation.
* Protection of machinery and equipment.
* Protection of metal door and window frames during installation and construction.
* Protection for glass blocks, mirrors, ceramic surfaces, etc. during construction and painting.
* Temporary protection of finished hardware during fabrication, installation and construction.
* Protection of moldings and trim during installation.
* Protection for bathtubs, shower stalls, plumbing fixtures during installatic
* Masking for protection during painting or other finishing operations.
* Any other applications requiring surface protection during shipping, storage fabrication, inter-plant movement.

Continued

APPLICATION

Protexo-Cote V-12 is applied by ordinary paint methods such as brush, spray or roller coat, or by cold dipping at room temperatures. It dries to a tough, flexible film within ten minutes. Protexo-Cote V-12 comes ready to use direct from the can or may be further thinned by using the special solvent blend available below. Lacquer thinner may be used for cleaning spray equipment, brushes, etc.

One brush coat usually provides enough film thickness (approximately 4 mils) for protection from average hazards. Where unusual conditions are to be encountered, multiple coats can be applied for additional protection.

In order to spray PROTEXO-COTE V-12 at the viscosity at which it is shipped to you, a commercial type, pressure pot or spray cup and spray gun are necessary. The spray gun should have a solution adjusting screw for controlling the amoun of solution passing through the spray nozzle; a spreader adjustment valve for controlling the width of the spray fan; an air cap for adjustment of a horizon tal or vertical spray pattern and a fluid spray nozzle having a diameter of .07-.001 inch.

To obtain a good film, it is recommended that a 15 psi pressure be maintained at the pressure pot and a #66 Binks Spray Nozzle on the spray gun. This combination should give you a film of approximately 5 mils on one pass.

CIFICATIONS

Protexo-Cote V-12 comes in 1 gallon friction top cans, 5 gallon containers and 55 gallon drums, and is ready to use. Stirring before use is suggested with t pigmented types.

It is available in clear, aluminum, and red (transparent), as standard colors and in almost any other color, at slight extra cost. Where complete transparency is not of importance, the colored types are suggested, as it is easier to tell the thickness of film by the degree of color.

Although called an interim or temporary coating, Protexo-Cote V-12 will actual give long lasting protection. Tests indicate a useful life of at least one ye and more under outside conditions and an indefinite, long, protective life ins

Average coverage (one coat) 300 to 400 sq. ft. per gallon.

CES	Gallon Cans	5 Gallon Pails	55 Gallon Drums
Protexo-Cote V-12	$4.95 per gal.	$4.75 per gal.	$3.95 per gal.

V-12 Solvent Blend Thinner - $1.80 per gallon.

All prices are F.O.B. Paterson, N.J.

WRITE for evaluation sample and quantity prices!!

rust, abrasion, corrosion protection on smaller, precision machined tools and ts, investigate our Thermo-Cote hot melt, protective, strippable coatings. ckly applied by dipping. These coatings offer the ultimate in protection.

Thermo Cote Inc.

PROTEC
COATI

CODE 201 • ARMORY 8-2000 798 21ST AVENUE • PATERSON, NEW JERSEY 0751

PROTEXO-COTE BL

STRIPPABLE PROTECTIVE COATING
(Brush or Spray or Cold Dip Application)

PROTEXO-COTE BL - is a water dispersed plastic in a liquid form, designed for easily applied interim protection of all types of metal, ceramic, glass, and other surfaces. This tough Protexo-Cote BL coating protects the surface from such hazards as scratches, rust, abrasion, dirt, corrosion, and yet is easily stripped off when the clean surface is needed.

Protexo-Cote BL brings the advantages of interim surface protection to large or unusually shaped objects that cannot be protected by our Thermo-Cote hot melt protective coatings, which must be applied by dipping the object. Since Protexo-Cote BL is applied by brush or spray, it can be used on large sheets, big equipment, long objects, or any other surface it's possible to reach with a paint brush.

This tough, flexible Protexo-Cote film is easily removed when the need for protection is over, by merely lifting one corner of the film and peeling the film off the object. Becau of its strength and elasticity, the film usually is stripped o in one sheet.

SOME SUGGESTED USES FOR PROTEXO-COTE BL

* Protection of polished metal sheets and shapes during fabri cation, shipping, storage or installation.
* Protection of machinery and equipment.
* Protection of metal door and window frames during installa tion and construction.
* Protection for glass blocks, mirrors, ceramic surfaces, et during construction and painting.
* Temporary protection of finished hardware during fabricati installation and construction.
* Protection of moldings and trim during installation.
* Protection for bathtubs, shower stalls, plumbing fixtures during installation.
* Masking for protection during painting or other finishing operations.

* Any other applications requiring surface protection during shipping, storage, fabrication, inter-plant movement.

EASY APPLICATION

Protexo-Cote BL is applied by ordinary paint methods such as brush, spray or roller coat, or by cold dipping at room tempera tures. It dries to a tough, flexible film within one hour. Protexo-Cote BL comes ready to use direct from the can or may b further thinned by using water.

One brush coat usually provides enough film thickness (approxi mately 4 mils) for protection from average hazards. Where unusual conditions are to be encountered, multiple coats can be applied for additional protection.

SPECIFICATIONS

Protexo-Cote BL comes in 1 gallon friction top cans, 5 gallon containers and 55 gallon drums, and is ready to use. Stirring before use is suggested with the pigmented types.

Although called an interim or temporary coating, Protexo Cote B will actually give long lasting protection. Tests indicate a useful life of at least one year and more under outside conditi and an indefinite, long, protective life inside.

Average coverage (one coat) 300 to 400 sq. ft. per gallon.

PRICES	Gallon Cans	5 Gallon Pails	55 Gallon
Protexo-Cote BL	$4.95 per gal.	$4.75 per gal.	$3.95 per

All prices are F.O.B. Paterson, N. J.

WRITE *for evaluation sample and quantity prices!!*

For rust, abrasion, corrosion protection on smaller, precision machined tools and parts, investigate our Thermo-Cote hot melt, protective, strippable coatings. Quickly applied by dipping. These coatings offer the ultimate in protection.

DIP.....IT'S ON STRIP.....IT'S OFF

U.S. Polymeric
AN ARMCO COMPANY

PROTECTIVE COATINGS For Corrosic Protecti

PC-8151 Black/PC-8152 Primer
Low Permeability Coating for Tank Lining

APRIL 1972

DESCRIPTION

PC-8151 coating is a two-component, sprayable butyl rubber coating compound specifically designed for low vapor permeability, resistance to ultra-violet rays, acid and alkali resistance. It is also available in a light tan version PC-8150.

SUGGESTED APPLICATIONS

These materials are designed as protective coatings for metal tanks and containers. Tanks coated with PC-8151 are protected from attack by acids, bases and long term outdoor exposure. This product is especially suitable for the protection of concrete buildings, foundations, reservoirs and canals from damage by acidic and alkaline solutions or by weathering.

UNIQUE APPLICATIONS

As compared with other sprayable butyl rubber coating compounds, the PC-8151 material has the unique characteristics of shorter tack-life, higher tensile strength, better elongation and faster cure.

METHOD OF APPLICATION

PC-8151 material is available in two-components of 1:1 volume ratio. They can easily be sprayed by an airless two-component spray gun. For evaluation purposes, the two components can be easily mixed together by a stirring mixer, then applied with brush or wiper bars.

Experience has shown that optimum properties may be obtained using a 1:1 ratio Graco President Hydra-Cat airless unit. This system utilizes a 207-618 Graco Gun, 208-056 mix tube and tip variations from a 163-625 (60° fan — .025" orifice) to a 163-643 (60° fan — .043" orifice). It is further suggested that the static mix tube be used in conjunction with a pre- and post-orifice.

Tip Size	Pre-Orifice	Post-Orifice
.025"	.034"	.032"
.029"	.034"	.032"
.033"	.036"	.034"
.037"	.041"	.039"
.043"	.049"	.047"

Selection of tip and orifice sizes should be based upon prevailing factors such as wind, operator technique, surface condition, and operating line pressure.

For coating of clean and dry concrete, brick or other masonry surfaces it is recommended that a wash coat of PC-8152 Primer be applied by airless spray at a nominal dry film thickness of ½ mil. In coating mild steel a sand blast to white metal is recommended to be followed immediately by the application of ½ mil nominal PC-8152 Primer. For application to other surfaces consult U. S. Polymeric.

The butyl coating should be applied at the rate of two gall minimum per 100 square-feet. This should be done in coats with approximately two hours between coats. One g lon of PC-8151 applied to 100 square-feet should yi approximately 7.5 mils depending upon the spraying te nique, amount of overspray, and surface condition.

Spray equipment should be cleaned with Toluene by re cling through the system for ten minutes followed by flush and the addition of clean solvent. This solvent should allowed to remain in the lines during the time the equipm is being stored. Care must be exercised to avoid fire haza and to avoid prolonged skin contact. Organic vapor cartri respirators must be worn when spraying the coating cleaning the equipment.

PC-8151 may be applied to a surface with a temperat range of 40°F. to 120°F. The A and B components sho be maintained at a temperature of 50°F. - 90°F. The te perature of the components should not be permitted to re more than 110F° at any time.

PC-8151 Series PHYSICAL PROPERTIES

The following are representative physical properties o the PC-8151 series:

Lb/Gal		8.17
Solids by volume, percent		45
Brookfield Viscosity, cps		
Component A		
#5 Spindle Speed at	4 rpm	7,500
	10 rpm	3,400
	20 rpm	2,000
Component B		
#5 Spindle Speed at	4 rpm	8,800
	10 rpm	4,200
	20 rpm	2,300
Shore A Hardness		65
Tensile Strength, psi		410
Elongation, percent		220
Water Vapor Transmission ASTM-E96-66 Method E (20 mil) Perms.		0.04
Time to touch, hr.		2
Color		Black
Weather-O-meter 2,000 hrs.		No Degradation

CHEMICAL RESISTANCE

The chemical resistance of PC-8151 is obtained in an accelerated aging condition by determining the percent retention of tensile strength and elongation after soaking the cast in various chemical solutions at 150°F.

	Percent Retention After One Week		Percent Retention After One Month	
	Tensile	Elongation	Tensile	Elongation
10% sulfuric acid	100	100	100	94
25% acetic acid	98	100	86	100
10% nitric acid (1)	89	100	83	100
chromic acid (1)	89	92	91	92
haylage	100	100	86	97
silage	89	100	82	92
10% sodium hydroxide	100	100	100	100
10% lime	100	100	100	100
10% ammonium hydroxide	92	100	62	99
sea water	100	100	100	100
ethyl acetate	100	100	100	100
brake fluid	100	100	97	84
vegetable oil	82	95	69	95
Skydrol 500B	85	100	72	100
Chlorox	100	100	100	100
MEK	100	100	95	100
DMF	77	86	62	83

This product is not recommended for service in contact with hydrocarbons.

We suggest that you contact your local USP technical representative to discuss your specific requirements.

NOTE (1) - Although the retention of physical properties is good, the surface of film shows signs of being oxidized.

NOTE: All data given are typical and do not provide an adequate statistical basis for specification purposes. Representat made are believed to be valid; however, seller makes no warranty of any kind concerning the use of this product.

WARNING: Flammable Solution

Keep away from heat and open flame.
Keep container closed.
Use with adequate ventilation.
Avoid prolonged breathing of vapor.
Avoid prolonged or repeated contact with skin.

PC-8220

PROTECTIVE COATING AND MASKANT

DESCRIPTION

PC-8220 is a synthetic elastomer and hand strippable protective coating which contains a super gel structure interwoven into the lattice of the polymer system that not only produces rapid film formation, without runs or sags, but also has excellent chemical resistance to caustics, acids and salt air environment. This coating system may be hand peeled and can also be solvent or perchlorethylene vapor stripped to reduce time and labor. The solvent system used in this formulation conforms to Rule 66 of the Los Angeles Air Pollution Control District.

SUGGESTED APPLICATION

This coating system is designed as a strippable protective coati for use on metal parts and structures that require protection against chemical and salt air environment corrosion or damage during storage or handling. Large surfaces may be quickly and economically hot airless sprayed, dipped or flowcoated. To achieve maximum protection and vapor strippability, a 275°F cure is recommended.

METHOD OF APPLICATION

1. For hot airless application, 170 ± 10°F, use as-is without thinning. Maskant drum should be provided with mechanical agitation to prevent phasing or separation of chemical components.

   a. Apply one medium pass, allow solvent to flash off, then apply final full pass to achieve 8 - 14 mils dry film.

   b. Heat cure a minimum of one hour at 275°F after 16 hours air cure if parts are to be vapor stripped in trichloroethylene, 1,1,1, trichloroethane, or perchloroethylene (cold solvent stripping may also be employed).

2. For cold airless application, thin approximately 10% by volume with a special Rule 66 solvent available from U. S. Polymeric.

3. For dip application, use as-is. Apply two or more dips. Dry until tack-free between coats. Cure as above.

GENERAL PROPERTIES

Type	Synthetic elastomer
Color	Translucent, amber
Brookfield Viscosity, (Spindle #2 at 20 rpm)	600 - 800 cps
Solids	25 ± 1%, by weight
Coverage	400 sq ft/mil/gallon
Stability	6 - 7 months minimum in closed containers @ 80°F

FILM PROPERTIES

(Hot airless sprayed, air dried 16 hours)

Appearance	Smooth, slight sheen
Adhesion -	
Clad Al	1.0 - 1.5#/lin. inch
Bare Al	1.0 - 2.0#/lin. inch
Titanium - 6 AL, 4V, sandblasted	3.0 - 5.0#/lin. inch
Tensile	1400 psi minimum
Elongation	650%

SUGGESTED EQUIPMENT

1. Graco President (28:1) or Bulldog (30:1) hot airless spray unit or equivalent.

2. Graco air activated reflux gun, #206-717, Series A.

3. For large parts, use Graco tips #205-614 and 719, Reverse-A-Clean nozzle to facilitate cleaning clogged tips or #163-824 fine finish tip.

   Medium parts, #163-620 or 618 fine finish tip
   Small parts, #163-420 or 418 fine finish tip

. Two Graco #206-565 (115V) or two #206-580 (240V) heaters adapted with 690-688 insert rods for maintaining temperatur at ± 10°F.

. Graco filter #167-053, 60 mesh stainless steel scrim.

PRESSURES AND TEMPERATURES

1.	Temperature	170 ± 10°F
2.	Back Pressure	1600 to 2100 psi
3.	Line Pressure	80 to 120 psi

Apply as follows:

a. Hold spray gun approximately 10 - 12 inches from the pa
b. Spray 1/2 box coat, that is one vertical pass, overlap 75 - 80% for tack coat.
c. Spray one box coat, that is one vertical pass and one horizontal pass, overlap 50%.

SAFETY PRECAUTIONS

The application of PC-8220 should be performed in well ventilat areas with positive air flow for the spray operators. Threshol limit values of component solvents formulated within the coatin are standard and well within recommended limits. Comply with a local safety precautions.

NOTE: This Product Data Bulletin is subject to change and customer will be notified.

NOTE: All data given are typical and do not provide an adequat statistical basis for specification purposes. Representations made are believed to be valid; however, seller makes no warrant of any kind concerning the use of this product.

U.S. Polymeric, Inc.

PC-8230

PROTECTIVE COATING AND MASKANT

DESCRIPTION

PC-8230 is a synthetic elastomer and a hand peelable protective coating formulated to exhibit excellent resistance to acids, caustics, salt air environment and ultra-violet radiation. This coating system has outstanding toughness and sufficient adhesion for complete protection, but can be easily hand peeled when desired.

SUGGESTED APPLICATIONS

PC-8230 is designed as a strippable protective coating for use on metal parts and structures that require protection against chemical corrosion or damage during storage or handling. It can be applied by brush, dip or spray methods.

METHOD APPLICATION

1. Stir the material, then apply 2 - 4 coats. Allow 5 - 30 minutes solvent flash between coats depending on method of application and air temperature.

2. For hot airless spraying with Graco equipment use as-is, no further thinning is required. Set heaters to 170 ± 2°F. Apply the first pass or tack coat wet but not very heavy. For spraying small parts, a 5 - 10 minute flash time may be necessary. For large parts, additional coats may be applied immediately. Apply a heavy uniform film with 50% overlap. Properly and uniformly applied film will be smooth and almos free of air bubbles.

3. For cold airless application, thin approximately 10% by volume with special Los Angeles A.P.C.D. Rule 66 thinner available from U. S. Polymeric.

4. For dip, flowcoat or brush application, use as-is without thinning. Proper non-turbulent mixing should be used in the tank. Use 2 - 4 coats depending on desired film thickness. For solvent replenishment, use Special Rule 66 thinner.

GENERAL PROPERTIES

Type	Synthetic polymer
Appearance	Translucent white
Solids	25% by weight minimum
Brookfield Viscosity (spindle #2 at 20 rpm)	400 - 700 cps
Density	7.2 ± 0.3 lbs/gal
Tack Free Time	5 minutes minimum
Storage Life	6 months in closed original container

FILM PROPERTIES

Appearance	Smooth, satin sheen
Tensile Strength	2000 psi minimum
Elongation	400% minimum

SAFETY PRECAUTIONS

WARNING - FLAMMABLE

Keep away from heat and open flame. Keep container closed when not in use. Use with adequate ventilation. Avoid prolonged or repeated breathing of vapors. Comply with all local safety precautions.

NOTE: All data given are typical and do not provide an adequat statistical basis for specification purposes. Representations made are believed to be valid; however, seller makes no warrant of any kind concerning the use of this product.

WD-40 TECHNICAL DATA and SPECIFICATIONS

WD-40 is a specially compounded, silicone free, organic material which displaces moisture, prevents corrosion, penetrates and serves as a prevent corrosion on all metals exposed to a variety of corrosive conditions, while at the same time lubricating a multitude of bearing surfa and free fasteners, hinges, bolts, etc., which are frozen with rust and corrosion.

APPLICATION PROCEDURES: WD-40 may be applied by:

1. Spray (aerosol or conventional spray equipment)
2. Swab or brush
3. Dip

Note: Water-wet parts may be treated while wet as WD-40 acts immediately. In some cases when wet parts are dipped *directly in* WD-40 without drying the displaced moisture will build up in the bath and form an emulsion with the WD-40. This in no way affects the efficiency of the WD-40 until the amount of water present exceeds 50% of the total.

PHYSICAL CHARACTERISTICS

APPEARANCE	Clear or slightly cloudy
COLOR	Light amber
ODOR	Very slight characteristic pleasant odor
SPECIFIC GRAVITY	.800 ±.020 at 72° F.
VISCOSITY	27.5 ±1.0 sec. Zahn #1 at 72° F.
FLASH POINT (MINIMUM)	110° F. open cup
PERCENT NON-VOLATILE (MINIMUM)	22% by weight
PERCENT VOLATILE (MAXIMUM)	78% by weight aliphatic petroleum distillate
POUR POINT	Less than —100° F.
LOW TEMPERATURE STABILITY	Excellent (Sample cooled to —100°F. and warmed to ambient temperature four times with no resultant change)
COVERAGE	600 to 1000 sq. ft. per gallon
BOILING POINT (INITIAL)	300° F. (minimum)

PHYSICAL PROPERTIES, applied coating

WEIGHT	3.4×10^{-4} lbs./sq. ft.
THICKNESS	.0001 to .0003 inch
TEMPERATURE RANGE	Effective from —100° F. to 300° F.
DYNAMIC COEFFICIENT OF FRICTION	Heat treated 4340 steel with normal blue oxide film against itself lubricated with WD-40.

BEARING PRESSURE	COEFFICIENT
100 psi	0.112
1000 psi	0.114
2000 psi	0.129
3000 psi	0.138
4000 psi	0.145

Contact Resistance (using fine silver contacts in a modified ASTM B 182 apparatus and procedure) — Measured at 10 amps and 12 volts DC before and after make and break cycling with a contact pressure of 100 gram. and 23 amps, 114 volt AC load.

	WD-40 treated contacts	Bare contacts	Contact Resistance of film
before cycling	0.0083 ohm	0.0066	0.0017 ohm
after 5 cycles	0.0085 ohm	0.0067	0.0018 ohm
after 100 cycles	0.0086 ohm	0.0069	0.0017 ohm
after 1000 cycles	0.0085 ohm	0.0074	0.0011 ohm
after 20000 cycles	0.0098 ohm	0.0083	0.0016 ohm

Breakdown voltage ASTM D-877, 7 (b) @ 78° F. ±1° F. — 12,000 v. per 0.100 in.

LENGTH OF CORROSION PROTECTION: (on freshly sanded mild steel panels)

Exposure	Results
Humidity (JAN-H-792)	No rust after 1000 hours
Salt Spray (FED STD 151)	No rust after 50 hours
Salt Spray (FED STD 151)	Rust beginning after 100 hours

Under actual conditions the duration of protection obtained using WD-40 will vary with the type of material being protected and the conditions of exposure. Generally, on mild steel the protection under various conditions will be approximately as follows:

1. Covered or indoor storage	1 year or longer
2. Protected exterior storage	6 months to 1 year
3. Normal exterior exposure	30 to 60 days
4. Severe exterior exposure	15 to 30 days

EFFECT ON VARIOUS MATERIALS

Rubber — No visible effects on surfa rubber sprayed with WD-40. will swell upon prolonged in

Painted surfaces — Many types of paint on var exposed to WD-40 with no e certain wax coatings may b subject to prolonged exposur

Plastics — The following plastics were 168 hours with no visible eff

- Formica
- Acrylic Sheet
- Polyester—fiber glass
- Epoxy—fiber glass lam
- Vinyl Sheet

Fabrics — The following fabrics were e effect, except slight stainin moved with naphtha or dry c

- Nylon
- Orlon
- Wool

Application of Paint over WD-40 — The adhesion of some pain impaired when applied direc surface. Simple solvent cle mineral spirits or vapor deg WD-40 treated surface for pa

High strength steels (for hydrogen embrittlement) — Certified SAFE according to Effusion Test (Lawrence Ele 1223 & 1224, 7 May 1964, Ce

WD-40 COMP

5390 Napa Street

San Diego, California 9211C

Telephone 297-4938 (Area C

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APPENDIX L

PNEUMATIC EQUIPMENT DATA

PNEUMATIC EQUIPMENT MANUFACTURERS CONTACTED

L-1 Aerospace Components Corp.
11650 W. Olympic Blvd.
Los Angeles, Calif. 90064

L-2 Anderson Ibec
1935 W. 69th St.
Cleveland, Ohio 44102

L-3 R. P. Adams Co.
209 E. Park Drive
Buffalo, N.Y. 14240

L-4 Deltech Engineering Inc.
Century Park, New Castle, Del. 19720

L-5 Gas Drying Inc.
Box D
Wharton, N.J. 07885

L-6 General Air Drying Div.
Zurn Industries Inc.
Erie, Pa. 16512

L-7 Hankison Corp.
College and Pike Rds.
Canonsburg, Pa. 15317

L-8 Ingersoll-Rand
Air Power Compressor Div.
Corning, N.Y. 14830

L-9 Kahn & Co. Inc.
885 Wells Rd.
Wethersfield, Conn. 06109

L-10 C. M. Kemp Mfg. Co.
Glenburnie, Md. 21061

PNEUMATIC EQUIPMENT DATA
(Cont'd)

L-11 McGraw-Edison Co.
Lectro Dryer Div.
Pittsburgh, Pa. 15205

L-12 Pall Trinity Micro Corp.
Route 281
Cortland, N.Y. 13045

L-13 Racor Industries, Inc.
1215 8th St.
Modesto, Calif. 95354

L-14 Rix Industries
6448 Bay St.
Emeryville, Calif. 94608

L-15 Serfilco Div.
Service Filtration Corp.
7435 N. Harlem Ave.
Chicago, Ill. 60648

L-16 Van-Air Inc.
Erie, Pa. 16505

L-17 Wilkerson Corp.
1200 W. Mansfield
Englewood, Colorado 80110

PNEUMATIC EQUIPMENT-REFERENCE DESIGN DATA

L-18 Excerpt from Plant Eng'g. Handbook
2nd Edition (McGraw-Hill)
"Water in Compressed Air"

L-19 Excerpt from Plant Eng'g. Handbook
2nd Edition (McGraw-Hill)
"Designing for Corrosion Resistance"

PNEUMATIC EQUIPMENT-REFERENCE DESIGN DATA
(Cont'd)

L-20	Excerpt from Tool Eng'g. Handbook 2nd Edition (McGraw-Hill) "Maintenance & Trouble Shooting of Air Circuits and Piping."
L-21	Excerpt from Compressed Air Magazine (Sept. '70) "Dry Air"
L-22	Excerpt from Hydraulics and Pneumatics Magazine (Apr. '71) "How Compressed Air is Dried"
L-23	Data Sheets for Kahn Co. Regenerative Air Dryer (3000 PSI)
L-24	Data Sheets for Hankison Co. Refrigeration Air Dryer (3000 PSI)

Table 12-68 should be useful in determining approximate horsepower requirements. Table 12-68 gives theoretical horsepower for use in the formulas in Table 12-71.

Water in Compressed Air

All atmospheric air contains moisture. The ability of air to hold this moisture increases with temperature and decreases with compression. Air temperature rises during compression, but in most cases it has dropped to room temperature by the time it reaches the point of use. The net result is that the air has lost its ability to hold the moisture that it originally contained, and the excess condenses in various parts of the distribution system. Since this moisture is detrimental to the operation of air tools and other air-operated equipment, it is essential to remove it.

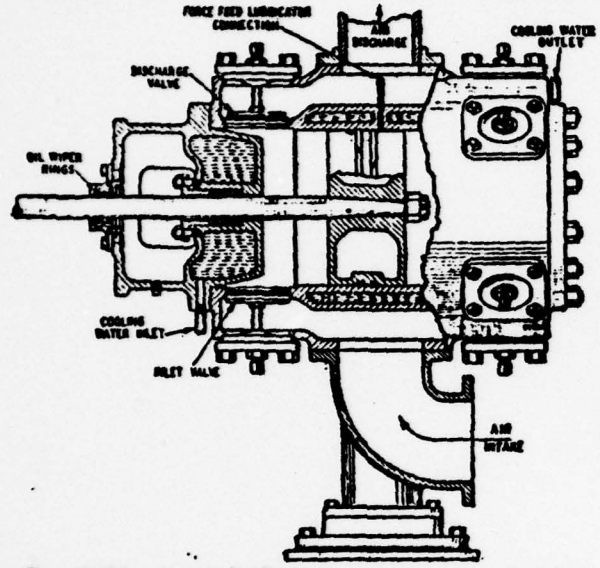


FIG. 12-208. A typical cylinder for a water-cooled compressor.

Intercoolers on multistage machines remove some of the moisture if they are equipped with automatic drains or manual drains which are regularly attended.

Aftercoolers are a solution to the problem in many instances. These are simple heat exchangers through which water is circulated to cool the air and thus force it to condense excess moisture. In most instances a single aftercooler of suitable size is installed between the air compressor and the receiver.

A number of different types of moisture separators are available. These are usually installed at strategic places in the distribution lines near the point of use. Unless regular attendance can be assured, such separators should be equipped with automatic valves for ejecting the moisture they collect.

It is good practice to have branch distribution lines going directly to tools come from the top of the main air-supply line. This prevents moisture which may collect in the main from running into the supply lines.

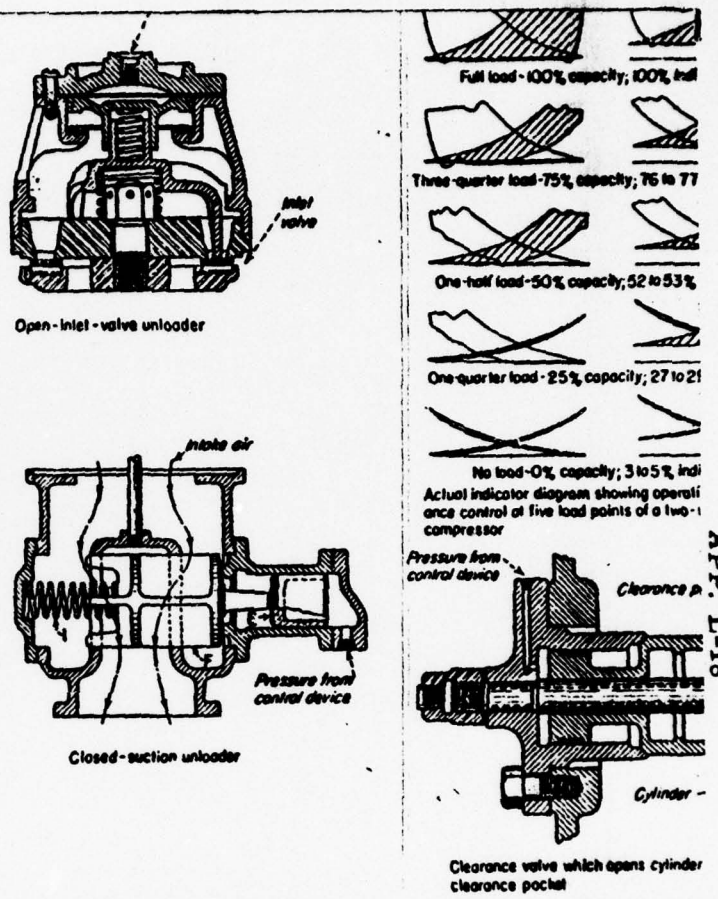


FIG. 12-209. Compressor unloading devices: (*Upper left*) Open-inlet-valv
(*Lower left*) Closed-suction unloader. (*Upper right*) Actual indicator diagram sl
ation of clearance control at five load points of a two-stage compressor. (
Clearance valve which opens cylinder into clearance pocket.

thus condense part of its moisture. The air receiver should be at least la
to hold all the air delivered by the compressor in 1 min. This may be c
follows:

Receiver size, cu ft

$$= \frac{\text{piston displacement or capacity, per min} \times \text{atmospheric p}}{\text{discharge pressure, psi, + atmospheric pressur}}$$

Air Receiver

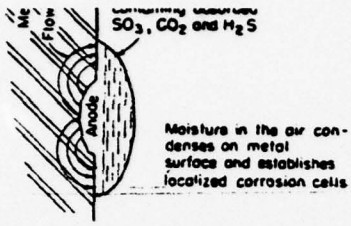


FIG. 5-7. Corrosion of metals in humid atmosphere.

In all cases, except where oxidation follows a rectilinear function, the oxide film formed on the surfaces of the metal becomes more protective as it forms. It was originally believed that oxidation proceeded and was controlled by the diffusion of oxygen inward through the oxide film. It is now known that metal ions also move outward through the oxide film and become oxidized at the surface. Actually both mechanisms probably occur during oxidation. This is illustrated by Fig. 5-9.

Corrosion by atmospheric gases and vapors is best controlled or prevented either by the use of more corrosion-resisting materials or by the application of protective coatings.

Corrosion by Fluids. Corrosion by fluids is of primary importance to the process industry and is second only to atmospheric corrosion in total wastage of metals. This type of corrosion is almost entirely electrochemical, since all metals in contact with an electrically conducting fluid have a tendency, known as the "solution potential,"

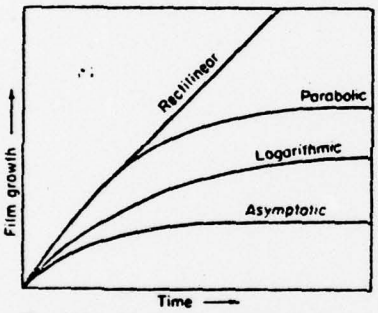


FIG. 5-8. Modes of metal oxidation.

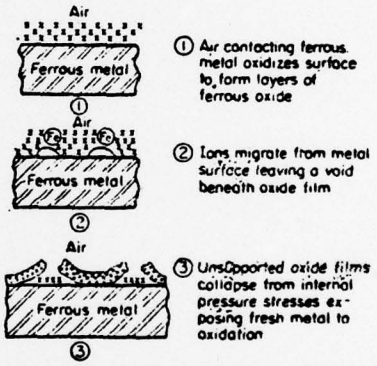


FIG. 5-9. Oxidation of ferrous metals.

to go into solution in the form of ions. When this occurs another metal or hydrogen must be displaced from solution. The ability of one metal to displace another from solution and the probability of corrosion are dependent upon the solution potentials of the metals, which is indicated by their relative position in the electromotive series shown in Table 5-1. Every metal in the electromotive series has a greater solution potential than the metals below it and will displace them from solution. In this series hydrogen behaves like a metal, and all common metals except copper, silver, and gold will displace hydrogen from solution.

Typical of the corrosion of metals by fluids is that of cast iron or steel. When steel is immersed in an aqueous solution, iron enters the solution by displacing hydrogen, as illustrated by Fig. 5-10. The surface where iron enters the solution is known as the "anode," and the area where hydrogen is displaced from solution is known as the "cathode." As long as there are hydrogen ions in the solution the corrosion process can continue. However, as corrosion proceeds the hydrogen formed at the cathode

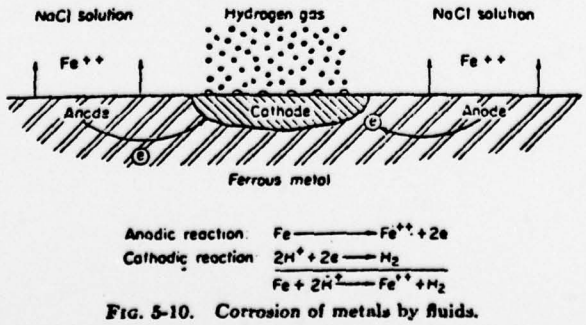


FIG. 5-10. Corrosion of metals by fluids.

is not immediately evolved and a gaseous layer is formed over the surface of the metal. This layer of hydrogen gas interferes with the flow of electrons by preventing ionic hydrogen from contacting the cathode and receiving the electron required to produce more nascent hydrogen. This reduction in the flow of electrons slows up the corrosion process and is called "polarization." When polarization occurs the metal is said to be "polarized."

Table 5-1. Electrochemical Series of Elements

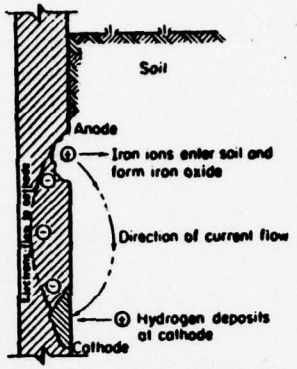
Element	Electrode potential at 77°F, volts	Element	Electrode potential at 77°F, volts
Lithium	−2.96	Cadmium	−0.402
Potassium	−2.922	Cobalt	−0.28
Barium	−2.90	Nickel	−0.25
Strontium	−2.87	Tin $\frac{Sn}{Sn}$	−0.136
Calcium	−2.716	Lead	−0.126
Sodium	−2.712	Hydrogen	0.000
Magnesium	−2.34	Bismuth	+0.226
Aluminum	−1.67	Copper $\frac{Cu}{Cu}$	+0.34
Manganese	−1.05	Silver	+0.799
Zinc	−0.762	Mercury $\frac{Hg}{Hg_2}$	+0.80
Chromium $\frac{cr}{cr}$	−0.557	Palladium	+0.82
Iron $\frac{Fe}{Fe}$	−0.441	Gold	+1.42

Anything that interferes with the removal of hydrogen from solution will slow up the corrosion process, while anything that aids in the removal of hydrogen from solution will speed up the corrosion process. The presence of oxygen or oxidizing salts in solution can accelerate corrosion by combining with hydrogen to form water. Oxygen can also reduce corrosion by oxidizing the metal going into solution to form an insoluble protective film on the surface of the metal. This is especially true for stainless steel and aluminum.

The addition of an alkali, such as caustic soda, reduces the corrosion of iron by reducing the hydrogen-ion concentration of the solution and thereby decreasing the number of hydrogen ions available for displacement. Conversely, the addition of an acid to a solution accelerates corrosion by increasing the hydrogen-ion concentration. Thus the hydrogen-ion concentration can determine the rate at which corrosion occurs.

A measure of the hydrogen-ion concentration in any solution is its pH value. The pH value of any solution is the logarithm (base 10) of the reciprocal of the hydrogen-ion concentration in gram-molecules per liter. Pure water accordingly has a pH 7, while acidic solutions have pH values below 7 and basic solutions have pH values over 7. It must be pointed out that the pH value is only an index of the fraction of ionized hydrogen present in solution, not a measure of total hydrogen. The pH value is a measure of the active acidity of a solution and can be used to predict the tendency of a metal to corrode. The total acidity is determined by titration and is a measure of the total number of hydrogen ions which are available for certain chemical combinations, but it is not a measure of the aggressiveness of a solution. For example, concentrated sulfuric acid is only very slightly ionized and can be handled satisfactorily in carbon-steel equipment, whereas dilute sulfuric acid is highly ionized and very corrosive to carbon steel. As applied to corrosion, the pH value may be considered as controlling the intensity of the corrosive action, while the total acidity is a measure of the amount of corrosion that can occur before the acid is exhausted.

As with atmospheric corrosion, temperature is a major factor controlling the rat of corrosion by fluids. In general, a rise in temperature increases the rate of the cor rosion process by increasing ionization and the mobility of all reacting-fluid phases Also, temperature may have an important effect upon surface-film formation and it solubility. Films forming at one temperature may not form at another, and, in gen eral, the solubility of the film increases with increasing temperature. Local differences ir solution temperature can establish localized galvanic cells and cause serious corrosion ir systems where corrosion would be negligible under uniform-temperature conditions.



Metal at anode is more electropositive to soil than metal at cathode, therefore, ferrous ions enter the moist soil and are oxidized. Simultaneously hydrogen ions move to cathode and are released as nascent hydrogen.

FIG. 5-11. Corrosion of steel in soil.

The velocity of corrosive fluids can have an effect upon the corrosion of metals used in the construction of pipe lines, valves pumps, heat exchangers, and agitated vessels Fluids moving at high velocity may damage protective surface films and accelerate corrosion in localized areas. In general, the flow of a corroding fluid across the surface of a metal relying upon a passive film for corrosion resistance should be streamline and not exceed a velocity of 6 to 8 ft per second.

Corrosion by fluids is best controlled by the use of more resistant materials, installation of corrosion-resistant linings, use of corrosion inhibitors, or application of cathodic protection.

Corrosion by Soils. The underground corrosion of structures is largely a function of the soil in which they are located. Soil characteristics vary considerably in different parts of the country. Soils containing water, oxygen, acids, and anaerobic bacteria are the most corrosive, while dry soils having high electrical resistivity cause a minimum of damage to buried structures.

Black iron or steel placed in moist soil assumes an electrical potential with respect to the soil it contacts. Variations in soil composition and in the metal result in different solution potentials at localized areas upon the metal surface, and if the soil is sufficiently electrically conductive to permit the flow of current, an electrochemical corrosion process is established. This is illustrated by Fig. 5-11. Aeration of the soil during excavation and backfill or the presence of oxygen in surface water accelerates corrosion by combining with hydrogen to form water, thereby assisting in depolarization of cathodic metal areas. Pipe lines and structures near the ground surface are most susceptible to this type of corrosion. Metal structures buried an appreciable depth, such as steel piling, very seldom corrode, because there is an insufficient amount of oxygen or oxidizing chemicals to depolarize the metal. Therefore

DESIGNING FOR CORROSION RESISTANCE

Introduction. In the design of structures and equipment for chemical-processing plants, considerations for corrosion resistance are secondary only to those for structural stability. No matter what merit a design may possess structurally, it will fail to fulfill its usefulness if resistance to corrosion cannot be maintained throughout the desired service life. The design engineer must at all times be cognizant of the various corrosive conditions existing throughout a plant so that he may anticipate corrosion problems and utilize the most suitable materials of construction and employ proper design and fabricating techniques.

Much has been written concerning the corrosion of metals, but little has been written regarding the proper application of design and fabrication techniques that will permit a metal to furnish maximum corrosion resistance. These techniques are not readily available in engineering handbooks and must frequently be obtained by analysis of failures and accumulation of service experience. Certain design and fabricating practices are known to contribute to the corrosion of metals and should be avoided. The following discussion concerns these undesirable practices and will point out features of good design.

Surface Conditions. The surface condition of a metal has considerable bearing upon its corrosion resistance. In general, a smooth surface furnishes greater resistance to corrosion than a rough one. A smooth surface possesses fewer crevices and indentations which might induce concentration-cell corrosion and offers less surface area on which attack may initiate. Also, certain metals, such as aluminum, lead, and stainless steel, rely entirely upon the formation of a protective surface film for corrosion resistance. This film is more readily formed and maintained upon a smooth surface than upon a rough surface.

Cleanliness of surface areas is of paramount importance in corrosion resistance. Corrosion is more likely to occur at inaccessible surface areas where dirt and other porous solids can accumulate than on areas that are kept clean. This is especially true around steel mills, soybean-meal-processing plants, fertilizer plants, and other plants where dusting and soot are a problem. In such plants the equipment and structures can become covered with porous solids which absorb and retain moisture for long periods of time. These moist pads create differential-aeration-cell corrosion that can rapidly perforate the metal beneath them unless the surfaces are properly maintained and protected by organic coatings. Such exposed surfaces should be cleaned frequently, and easy access must be provided for by the design engineer.

Carbon and low-alloy steels received from the mill or warehouse often have their surfaces covered with a hard, tenacious scale known as "mill scale." If this scale were continuous and uniform over the entire metal surface, it would furnish exceptionally good corrosion protection to the base metal in many environments. Unfortunately, mill scale is not continuous but contains interruptions and breaks which expose bare metal. Since mill scale is cathodic to bare steel, corrosion is concentrated at these discontinuities in the scale. This results in a serious pitting-type corrosion which can perforate the metal and cause failure. For this reason, carbon and low-alloy steel intended for use in corrosive environments should have the mill scale removed by pickling and/or sandblasting prior to installation. Sometimes it is advisable to apply special chemical treatments to steel surfaces after pickling and sandblasting to provide better corrosion resistance and protective-coating adhesion. One such treatment is the use of phosphoric acid compounds to produce a uniform phosphate coating on the surface of the metal. Most engineers are familiar with such treatments and recognize proprietary trade names like Parkerizing and Bonderizing. These treatments are often applied to building materials like steel sash to protect them against corrosion prior to application of organic coatings. Phosphate treatments can be used advantageously on any metal structure where temporary protection is desirable after sandblast cleaning. These surface treatments not only provide temporary corrosion protection but also provide a better surface for adhesion of protective coatings.

In the design of equipment and structures that are exposed to moisture and aqueous solutions, it is good practice to eliminate pockets and crevices where fluids can be trapped. Attachments should be designed to permit complete drainage, and faying surfaces of abutting component metal parts should be sealed by welding or calking to prevent crevice corrosion. Ledges and shelflike projections that permit entrainment of fluids can cause concentration-cell corrosion and should be eliminated. Consideration should be given to the application of protective maintenance coatings to external surfaces of metal structures. All surfaces should be accessible for inspection and maintenance. Physical characteristics which make the cleaning of the surface and application of protective coatings difficult should be eliminated. Joints in structural members should be welded wherever possible. Riveted and bolted joints are difficult to keep clean and effectively protected because working of the joint by thermal expansion and cyclic stresses loosen and crack applied coatings. Moisture can then enter the joint and initiate corrosion.

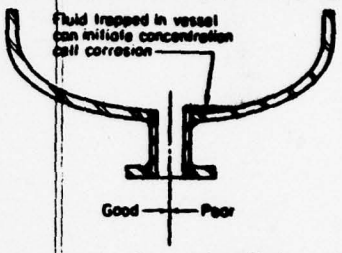


FIG. 5-16. Proper installation of vessel nozzle connections.

Since differential-aeration-cell corrosion is often initiated during idle periods of plant operation, all pipe lines, vessels, and other processing equipment should be installed to permit complete drainage of corrosive fluids. All fittings, nozzles, and connections in vessels and similar equipment should be designed and installed to facilitate drainage and prevent trapping of fluids. Figure 5-16 illustrates good and bad design and fabrication practice for the installation of vessel-nozzle connections.

Contact of metal surfaces with porous nonmetallic materials, such as wood, felt, cork, paper, cloth, and asbestos, should be avoided in wet and humid areas, since these materials can become saturated with moisture and encourage localized corrosion. Where such nonmetallic substances must be used as gaskets and expansion-joint materials in building construction, they should be saturated with coal-tar or asphaltic compounds that will prevent absorption of moisture. The faying surfaces of the metal should be protected with a suitable organic coating, and the joint exposed to the atmosphere should be sealed with a permanently flexible and adhesive calking compound. Catalytic curing thiokol and neoprene-rubber calking and sealing compounds are ideal for this application.

Water is used in many hydraulic systems to eliminate fire hazard or contamination of foods or dry goods sensitive to oils. However, before using water, care must be exercised to establish the suitability of all equipment for water service. Because water has little lubrication value, promotes corrosion, and has a much lower viscosity than ordinary hydraulic oils, components must be specifically designed for water service. Whenever possible, an emulsible oil-base additive should be added to water systems.

Fire-resistant liquids have been developed within the past few years which are far superior to water in that they have much better lubrication qualities, viscosities comparable with hydraulic oils, and lower suitable operating temperatures. Fire-resistant fluids should not be confused with the general term "synthetic fluids." Many of the silicones, silicate esters, dibasic acid esters, and polyglycol ester compounds offer poor resistance to fire. The basic types of fire-resistant fluids include the aqueous base, the phosphate base, and the chlorinated hydrocarbon fluids. These various types of fluids have many advantages and disadvantages too involved to discuss here.[6] However, it should be recognized that no fire-resistant fluid has yet been developed which can be indiscriminately interchanged with regular hydraulic oils. Lack of lubrication qualities, temperature restrictions, adverse effects on packings and seals, and other factors require care in selecting a suitable fire-resistant fluid.

Piping. The use of fully annealed seamless or electric-resistance-welded steel tubing is most commonly preferred for hydraulic systems, although copper tubing, iron pipe, or sometimes aluminum tubing is used. Galvanized pipe should never be used, since zinc flakes float loose and cause trouble. Considerable resistance has developed throughout industry to the use of copper or copper-bearing metals for tubing or fittings, because of the tendency for copper to work-harden and fracture under vibration, and also because copper-bearing metals can lead to corrosion problems under certain conditions. In any event, copper tubing, if used, should be dead soft. Hoses should be selected to conform with the temperature, pressure, and type of fluid to be encountered in service. All hydraulic lines should be sufficiently large to assure fluid velocities of under 15 fps on the pressure side, and under 4 fps on the suction side. All lines should be adequately supported so as to prevent components from having to carry pipe loads and also to prevent vibration. Also, consideration should be given to the possibility of improper spacing, which can lead to sympathetic vibration amplification. Under high-pressure conditions, tubes and pipes are prone to flex because of the Bourdon-tube principle and therefore should be better secured than from a simple load-carrying standpoint.

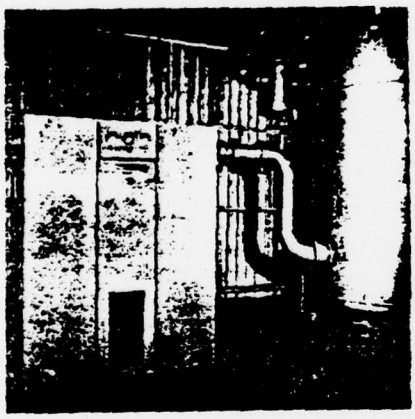
Air Circuits. In general, the maintenance of air circuits is easier than that of hydraulic circuits. Air leaks do not cause fire or contamination hazards, but they do cost money. A 1/16-in.-diam leak at 100 psi, for instance, will waste 182,000 cu ft of free air per month. Systems should therefore be kept tight. Water in air systems is a serious detriment, as it leads to corrosion, the washing away of lubrication, and trouble due to lines and equipment freezing in outdoor service. Water separation should start at the compressor through the use of an adequate intercooler and aftercooler. In addition, water separators, which are often combined with filters, should be located as near as possible to the equipment using the air.

Filters are essential to satisfactory pneumatic operation, because it is next to impossible to prevent lines from passing rust flakes and scale developed over a period of years.

Lubricators are also necessary for the well-being of pneumatic equipment. They should be located between the filters and the equipment using the air. Modern lubricators atomize the oil into a mist that travels to all parts of the circuit to provide necessary lubrication to valves, cylinders, and air motors. Too small a lubricator unit will not provide sufficient lubrication, and too large a unit will fail to provide the necessary venturi action to atomize the oil. For this reason, one large lubricator may not adquately lubricate a number of small cylinders operating one at a time.

Pressure regulators can reduce line pressures sufficiently to just do the job.

Cushions. Whenever shocks are anticipated, cylinder cushions should be specified. Some lines of cylinders are available with extra-long cushions which help solve severe shock problems. In addition, speed-control valves connected as closely as possible to the cylinder exhaust ports will contribute much to the elimination of shock problems. In general, no cylinder piston should ever be allowed to bottom at the end of its stroke with sufficient force to produce a hammer. Whenever possible, external stops should be provided for the cylinder load.



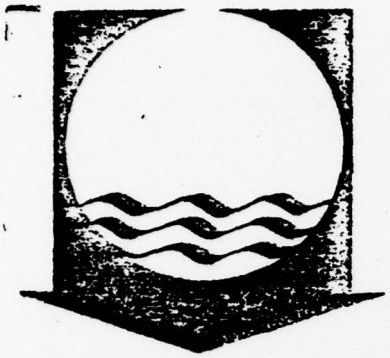
Surplus moisture is extracted by refrigerated drier, above at left, before compressed air is piped into foundry.

Dry air is a relative term. All atmospheric air contains some moisture in the form of water vapor, the amount depending upon the relative humidity, which is high at Jacksonville. U.S. Department Of Commerce figures list the yearly mean average there at 64 percent by day and 87 percent at night. A few other localities in the South equal the top figure of 87, but only one, Lake Charles, La., exceeds it.

Moisture in the form of vapor does no harm in compressed air systems, but when the vapor condenses, it corrodes the insides of piping, causing leakage; it also washes lubricant from the machines and tools being operated. Moisture has long been recognized as a thief of pneumatic efficiency, but until fairly recently, only limited effort was exerted to combat it, save where the air was used to operate delicate control instruments or for such purposes as food processing or spray painting. These limited efforts utilize intercoolers, aftercoolers, air receivers, and line traps, all equipped with drains to remove the condensed moisture.

A compressor taking in 100 cfm of air at 75° F temperature and 75 percent relative humidity—considered to be fairly average conditions—will handle about 18 gallons of moisture a day in the form of vapor. The compression process reduces the volume of the inlet air to about one-seventh of its original size; as it is at 75 percent of saturation, it is evident that this squeezing will condense a great deal of the vapor. Research shows that ordinary intercooling and aftercooling will remove about 68 percent, or 12.25 gallons of the water. The remaining 5.75 gallons will enter the piping system. The proportion of it that will condense there depends on how much further the air is cooled. In most distribution systems, the percentage is considerable.

In recent years, supplementary equipment has been developed to extract from compressed air, prior to distributing it, enough moisture to prevent any trouble. One such appliance operates on what is called the thermal mass principle of cooling. It utilizes mechanical refrigeration combined with a granular aluminum thermal mass. This design is used in Ingersoll-Rand Company's driers with capacity for handling from 5 to 1700 cfm of free air under compression.



How compressed air is dried

REVIEW OF FUNDAMENTALS

Why dry compressed air? For the best reason of all: TO SAVE MONEY.

If the air in your system isn't dry you can loose money through:

- production losses
- excessive maintenance costs
- excessive operating costs
- tool deterioration

The money you save by drying your compressed air can offset the cost of installing and maintaining the equipment to do the job.

What equipment is required? A complete drying system includes an aftercooler between the compressor and the receiver, separators and drain traps at critical points in the line, and either a chemical or a refrigerant dryer.

An important point to remember is that you may not need this elaborate a system. To understand why, it's necessary to know where the moisture in compressed air comes from in the first place.

Water, Water, Everywhere

There really *is* water everywhere, in the form of moisture in the atmosphere. All air has particles of water suspended in it as water vapor—the amount of water vapor in the air is expressed as the *relative humidity* of the air. When relative humidity reaches 100%, the air is *saturated*, that is, it can hold no more water in suspension at its present temperature and pressure.

The amount of water air can hold varies with temperature; the capacity of air to carry water doubles with every 20-F rise. When water-saturated air cools, water begins to condense; the temperature to which air can be cooled before its moisture condenses is its *dew point*.

When air is compressed, its temperature rises. As it leaves the compressor, the air begins to cool. Water will not condense in the air lines, however, until the air temperature drops below its dew point.

Now let's see how the equipment mentioned earlier helps lower the dew point of your compressed air.

Aftercoolers

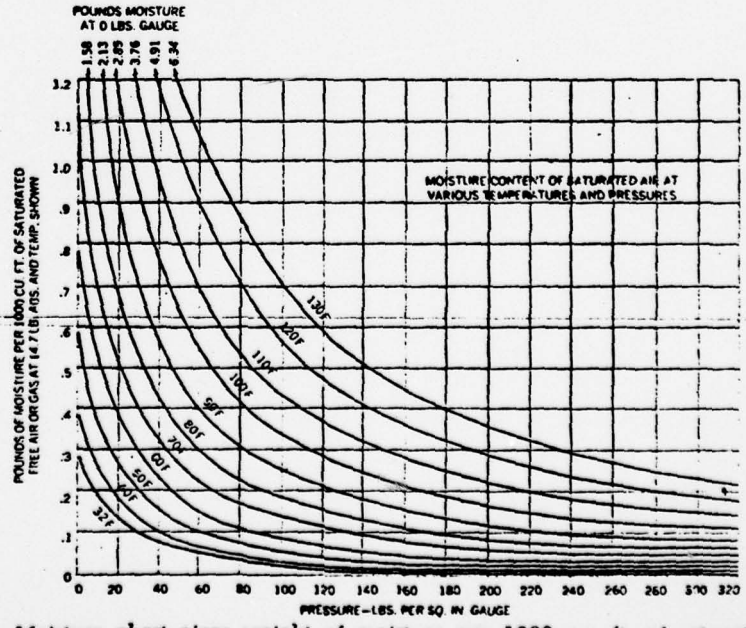
The shell-and-tube aftercooler is most common in industrial plants. As the name implies, it consists of a shell containing a bundle of tubes. Cooling air or water circulates through the shell, while the hot air flows through the tubes.

Shell-and-tube aftercoolers are usually piped for counterflow (air and water flow in opposite directions) for maximum temperature differences. In two-stage aftercoolers, water enters the first stage and proceeds through the second, while the air to be cooled enters the second stage and leaves from the first, again utilizing maximum temperature difference.

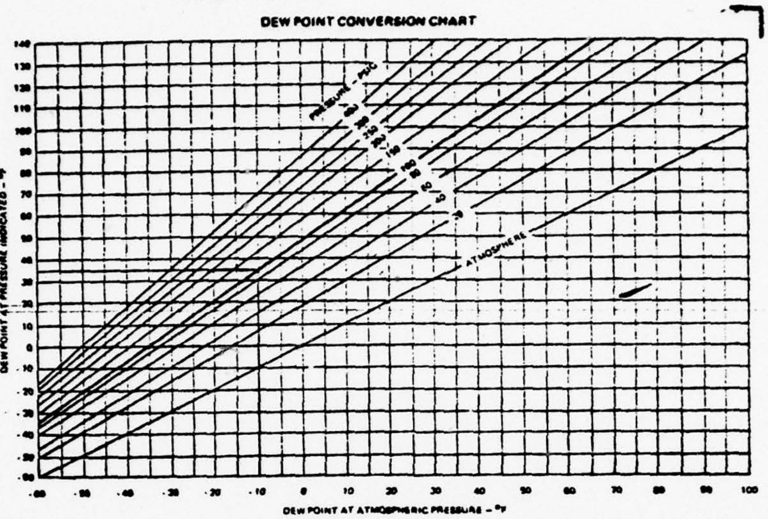
The temperature to which an aftercooler can cool air emerging from the compressor depends on the temperature of the cooling medium. Air-cooled aftercoolers generally cool compressed air to within 20-30 F of atmospheric temperature; water-cooled types will reduce the temperature of the compressed air to within 10-15 F above that of the cooling water.

It is important to remember that an aftercooler is only as good as its cooling medium. Although 70-80 F is a reasonable average temperature for cooling water available in industrial installations, many plants obtain their cooling water from water towers where temperatures may rise to 110F.

To illustrate how much water an aftercooler can remove from



Moisture chart gives weight of moisture per 1000 cu. ft. of saturated free air at atmospheric pressure for any temperature and working pressure.



Air with an atmospheric dew point of −10 F has a pressure dewpoint of 35 F at 100 psig. Courtesy Van Air, Inc.

compressed air, consider a system where the air leaves the compressor at 120 F, pressurized to 100 psig. Referring to the moisture content chart, we see that 1000 cu ft of this air contains about 0.56 pounds of moisture.

Assuming that the air passes through a water-cooled aftercooler using 75-F water, when it leaves the aftercooler the air will have a temperature of about 90 F. At this temperature, each 1000 cu ft of air will contain 0.2 pounds of moisture, a differential of 0.36 pounds per 1000 cu ft. The aftercooler removed 64.5% of the moisture from the air. Remember that this is true only for an aftercooler operating at 100% efficiency. Lower efficiencies will mean that proportionately less moisture is removed.

Separators and Drains

The moisture that condenses in the aftercooler is usually removed by a separator, which may be flange-mounted directly to the aftercooler.

Gravity separators base their operation on the difference in density between air and water, and upon air velocity, which creates a drag force that opposes the force of gravity. Gravity separators are usually limited to low-pressure service.

[illegible]

will remove all oil, leaving some water in the container.

Separators and drains placed in the air lines at low points and just upstream of the air's point of use will help trap additional condensed moisture.

Deliquescent Dryers

A deliquescent dryer contains a chemical that reacts with the moisture in the air, whether already condensed or still water vapor. The chemical is consumed in the drying process and must be replenished periodically. [illegible]

from air by adsorbing it on the surface of a solid desiccant, usually silica gel or activated alumina. The desiccant does not react chemically with the water so it need not be replenished. But it must be periodically dried or regenerated.

The simplest type of desiccant dryer requires that the compressed air be shut off while the used desiccant is removed and replaced with a fresh supply.

Heatless regenerative dryers use two identical chambers filled with desiccant. [illegible]

cle in these dryers usually lasts several hours, equally divided into heating and cooling time.

Desiccant dryers can produce atmospheric dew points as low as −100 F. The type of desiccant used has a definite effect on the final dew point. For example, for an equal amount of desiccant, the weight of activated alumina is 120% that of silica gel. Since drying is a function of desiccant weight, activated alumina may make it possible to use a smaller dryer than needed with silica gel.

Refrigerant Dryers

Refrigerant dryers condense moisture from compressed air by cooling the air in tubes chilled by refrigerants such as freon gas. These dryers will produce dew points of about 35 F at system operating pressure.

Many refrigerant dryers reheat the compressed air slightly after it has been dried, either with a heating element or by passing the cooled air back through tubes in contact with the hot, incoming air.

Refrigerant dryers must not be used where the ambient temperature is less than 35 F because lower temperatures will freeze the condensate, blocking air passages.

Choosing an Air Dryer

The most important criterion in choosing an air dryer is the dew point. Keep these factors in mind:

- dew point varies with pressure. For example, referring to the dew point conversion chart, an atmospheric dew point of −10 F is equivalent to a dew point of 35 F at 100 psig. Be sure you know whether a manufacturer is specifying the dew point his dryer can attain at atmospheric pressure or at a typical system pressure, such as 100 psig. If he specifies at atmospheric pressure, you can use the conversion chart to determine what the minimum dew point will be at your system pressure.
- required dew point varies with the application. If you are mainly concerned with preventing condensation in compressed air lines, the year-round ambient temperature in your plant will be the controlling factor (there may be fluctuations of 35 F or more from summer to winter). If, however, you are concerned with providing dry air to pneumatic tools or instrumentation, dew point requirements will be more severe, possibly as low as −40 F at atmospheric pressure.
- flow rate and duty cycle of the system.
- location of the dryer—will it be accessible for maintenance?
- consequences of a power failure if the dryer uses electrical controls or equipment.
- relative humidity, pressure, and temperature of the compressed air just prior to entering the dryer.
- initial cost of the dryer and the cost of maintaining and operating the dryer and its associated equipment.

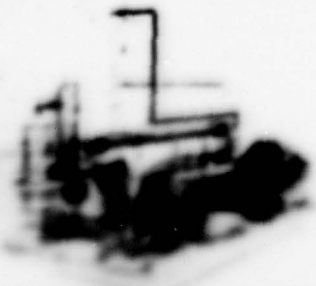
Throughout this report, we have included product information to highlight recent designs. The products can help you modernize existing systems and design new production equipment. For a complete guide to product manufacturers and specifications, refer to your January Issue: H & P's DESIGNERS GUIDE.

REPORT ON INNOVATIONS

ers might be able to reduce your ... consumption and piping costs ... using packaged drying systems ... these:

• compressor/dryer packages manufactured by Pneumo Dynamics Corp., Cleveland, OH, that incorporate a heat exchanger with an oil-free air compressor and include air filters, pressure relief valves, and a pressure gage, are given ...

Kahn & Co., Wethersfield, CT., see photo. Standard models have flow ...



Filter Engineering Co., Inc., Boston, MA, offers a filter/dryer with a built-in heater that maintains the air at 38 F, making this combination suitable for outdoor installations subject to freezing temperatures.

• aftercooler/dryer combinations, see photo, manufactured by General Air Drying Div. Zurn Industries, Inc., Erie, PA, that have ...

KAHN & COMPANY INC.

February 23, 1973

National Designers, Inc.
1219 Vine Street
Philadelphia, PA 19107

Attention: Mr. A. W. Volk

Subject: Kahn Quote 6050
Regenerative Air Dryer

Gentlemen:

Per your design requirements as shown on your sketch, I have att
our quotation covering our Model HPS-60, Regenerative Air Dryer,
conforming to your specifications as applicable to our product.
complete system is designed to provide backup for the primary de
tor already installed.

The HPS-60 Heaterless Air Dryer is a fully automatic unit which
ates on the principle of vapor pressure differential for reactivat
A repressurizing circuit is provided to equalize the pressures in
tower prior to switch-over which will prevent line surges and pro
desiccant life. The only utility requirement is a nominal 110 co
voltage.

The Prefilter is designed to remove 99.9% of all entrained liqui
and solids to a lower level of five microns. The unit is provid
with a drain. The Prefilter is recommended to prevent contamina
of the desiccant as the dryer is designed only to remove the water
The Afterfilter is offered to give final protection of downstrea
components from dust and other particles remaining in air stream
dehydration. The Dewpoint Indicator and the AG-4 Pressure Gage
offered to monitor the performance of the unit.

Further questions regarding the design or operation of our unit
be welcomed by Mr. Arnold of A-Tek Associates.

Sincerely,

KAHN & COMPANY, INC.

...hn and Company, Inc.

C & PNEUMATIC TEST EQUIPMENT — COMPRESSED AIR DRYERS — DYNAMOMETERS

CABLE: T...
OFFICI...
88...
WETHER...

DATE: February 23, 1973
TO: National Designers, Inc.
1219 Vine Street
Philadelphia, PA 19107

NTION: Mr. A. W. Volk

EMEN:

leased to quote you as follows:

KC Quote Number: 6050-1
Your Inquiry Dated.
Your Reference:

This Quotation Is As Checked Below

Original Quotation_____
Confirmation of Telephone Quote of _____
This Quotation Supersedes Our Quote No._____

(1) Automatic HPS-30 Heaterless Dryer rated at 30 SCFM at 3000 - ...
..., 105 F. inlet saturated and 0.12 G_R H_2O/lb. effluent. Power ...uirements 115/1/60, 250 watts, NEMA 1.

Price of Dryer only $3,140.00

RECOMMENDED ACCESSORIES INSTALLED:

One Oil Prefilter	$ 250.00
One 5 Micron Afterfilter	$ 200.00
One Color Change Dewpoint Indicator	$ 100.00

TOTAL PRICE YOUR NET. $3,690.00

... firm for 60 Days.
... Net 30 Days.
... 12 - 14 weeks.
... Eaton Plant.
... weight: 150 lbs.

Respectfully Submitted,
KAHN & COMPANY, INC.

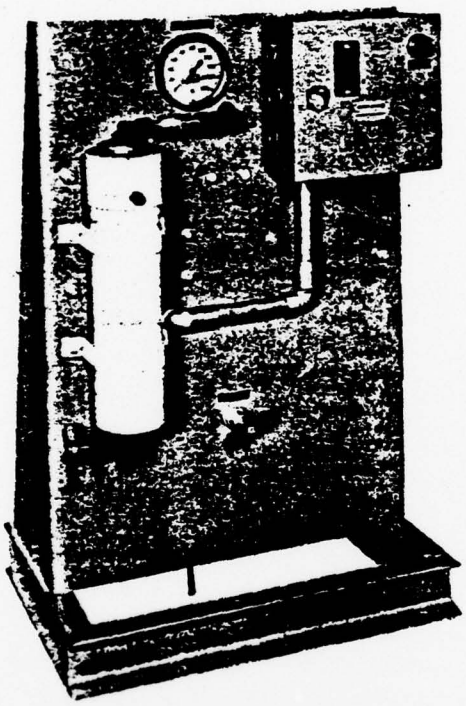
By _____

Kahn

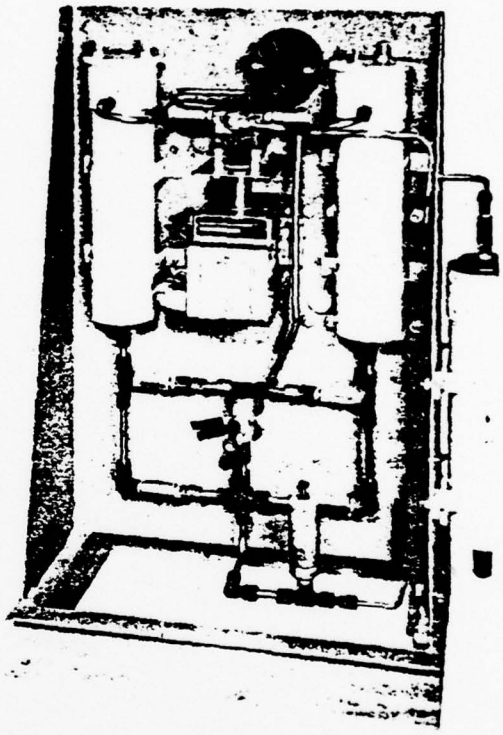
HIGH PRESSURE HEATERLESS COMPRESSED AIR AND GAS HPS SERIES DRYERS

FOR PRESSURES FROM 3000 PSIG to 10,000 PSIG

Model HPS-30
(Front View)



HPS-30 with Oil Vapor Filter
(Rear View)



DESCRIPTION

Kahn HPS series Heaterless Dryers are designed to dry air or other gases* at inlet pressures to 6000 PSIG and at temperatures of 80°F to 120°F. They provide dewpoints at atmosphere from to -120°F or lower, depending on the desiccant used, cycle time and purge flow.

Automatically operated, they are available in cycle times of 1 to 5 minutes per tower with p valve settings at 3000 PSIG, 5000 PSIG, or 6000 PSIG. Power requirements are 110V/1Ø/6 (250 watts maximum).

SPECIFICATIONS

	HPS-30	HPS-60
*Flow Rate		
Regeneration purge & blowdown		
Inlet & outlet connections		
Approx. shipping weight		

PENN-DEL SALES INSTRUMENT SALES INC.
MANUFACTURER'S REPRESENTATIVES
709 BETHLEHEM PIKE
PHILADELPHIA, PA. 19118
POST OFFICE BOX 4361
CHESTNUT HILL 7-9600

December 22, 1972

National Designers,Inc.
1209 Vine Street
Philadelphia, Pa.

Attention: Mr. A. Volk, Staff Engineer

MOD E-10(NO AUTO-TRAP)
$620.00 - 8 WKS. DEL'Y.

Dear Mr. Volk:

I spoke with you the other day in regards to your application for a Hankison refrigeration air dryer. With the information you have given me thus far- (3000 PSI - 1 to 5 SCFM) I would suggest an E-10 Stainless Steel Dryer.

I have enclosed some literature on the E-10 dryer. After you have reviewed this information, I will be in touch with you.

Thank you for your inquiry and if I can be of any further assistance to you, please do not hesitate to contact me.

ARMSTRONG AUTOMATIC TRAP RATED @ 3000 P.S.I. $1800.00 8 WKS DEL.

Best regards,

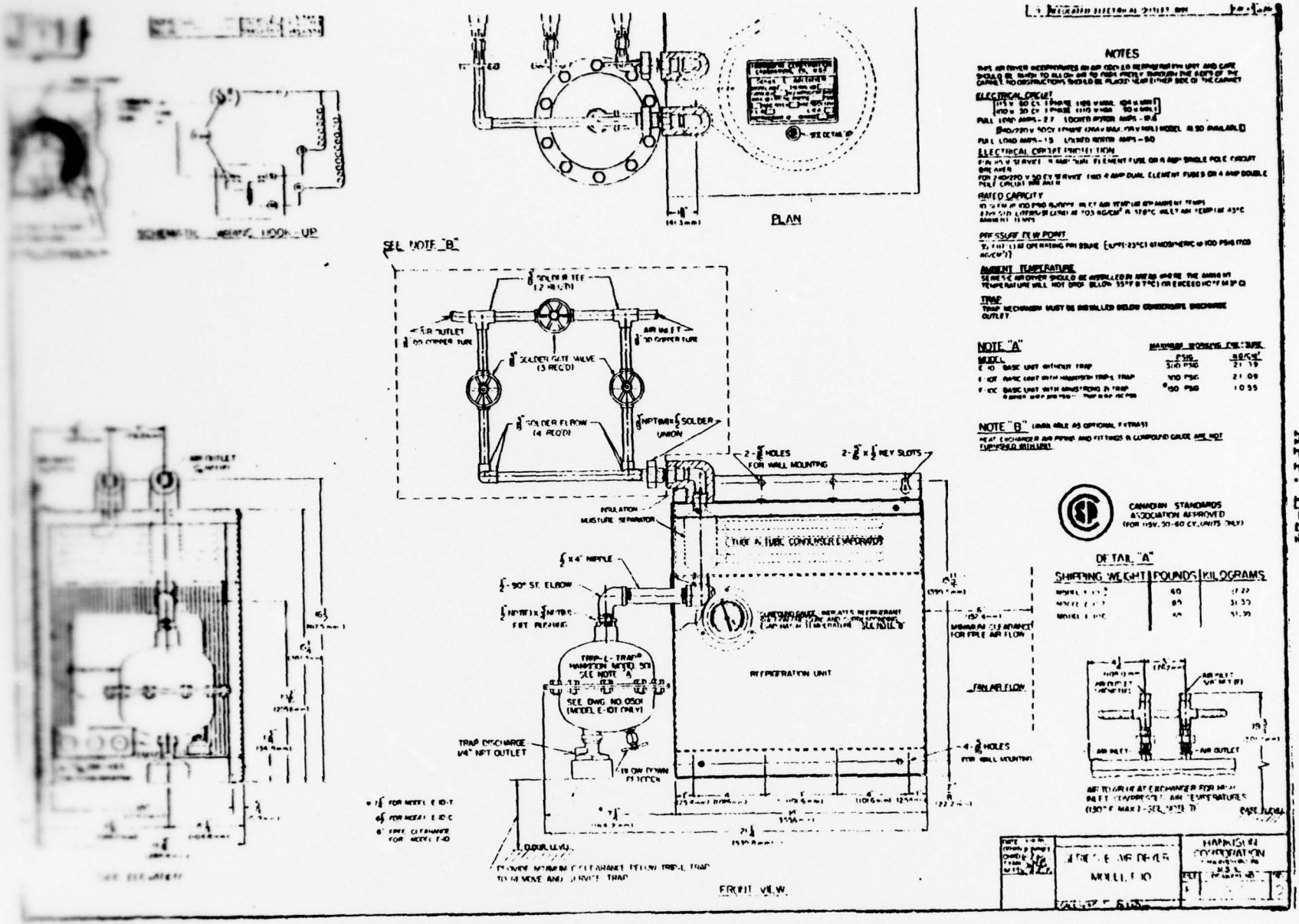
PENN-DEL INSTRUMENT SALES,INC.

Wayne H. Miller

Wayne H. Miller

3-2-73 COST DATA

WHM:mD
encl.


NOTES
ELECTRICAL CIRCUIT
ELECTRICAL CIRCUIT PROTECTION
RATED CAPACITY
PRESSURE DEW POINT
AMBIENT TEMPERATURE
TRAP
NOTE "A"
NOTE "B"
SEE NOTE "B"
SOLDER TEE (2 REQ'D)
AIR OUTLET
AIR INLET
SOLDER GATE VALVE (3 REQ'D)
SOLDER ELBOW (4 REQ'D)
INSULATION
MOISTURE SEPARATOR
TUBE & TUBE CONDENSER EVAPORATOR
REFRIGERATION UNIT
TRAP DISCHARGE
PLAN
FRONT VIEW
SIDE VIEW
CANADIAN STANDARDS ASSOCIATION APPROVED
DETAIL "A"
SHIPPING WEIGHT
POUNDS
KILOGRAMS
MODEL E-10